

4.2.8.3 Air Quality and Noise

Activities associated with the No Action Alternative would generate criteria and toxic/hazardous pollutants. The Pu Storage Phaseout Alternative would result in a decrease of criteria and toxic/hazardous pollutants over the No Action Alternative. To evaluate the air quality impacts at LANL, criteria and toxic/hazardous concentrations from the No Action Alternative are compared with Federal and State standards and guidelines. Impacts from radiological airborne emissions are described in Section 4.2.8.9.

Emission rates attributed to site operations (No Action) are presented in Table F.1.2.9–1. Air pollutant emission sources associated with operations include the following:

- Operation of existing boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- Exhaust and road dust generated by vehicles delivering supplies and bringing employees to work
- Toxic/hazardous pollutant emissions from facilities processes

Noise impacts during phaseout are expected to be low. Air quality and noise impacts for each alternative are described separately. Supporting data for the air quality and noise analyses are presented in Appendix F.

AIR QUALITY

An analysis was conducted of the potential air quality impacts of emissions for the Pu Storage Phaseout Alternative as described in Section 4.1.3.

Section 176 (c) of the 1990 CAA amendments requires that all Federal actions conform with the applicable SIP. The EPA has implemented rules that establish the criteria and procedures governing the determination of conformity for all Federal actions in nonattainment and maintenance areas. These are discussed in Section 4.1.3. The attainment status of the area in which LANL is located is discussed in Section 3.9.3. Since the area is considered to be an attainment area for the criteria pollutants, the proposed actions at this site do not require that a conformity analysis be performed.

Preferred Alternative: No Action Alternative

This alternative utilizes estimated air emissions data from total site operations at LANL, assuming continuation of site missions to calculate pollutant concentrations at or beyond the LANL site boundary. The emission rates for criteria and toxic/hazardous pollutants for No Action are presented in Table F.1.2.9–1. Table 4.2.8.3–1 presents the No Action concentrations calculated from the 2005 emission rates. In this table, pollutant concentrations are compared with applicable Federal and State regulations and guidelines. Concentrations are expected to remain within these standards.

Phaseout

Phaseout of existing Pu inventories as a result of consolidating Pu at another site is expected to result in a small reduction in air pollutant concentrations from the No Action concentrations. Concentrations are expected to remain within the standards.

Table 4.2.8.3–1. Estimated Operational Concentrations of Pollutants at Los Alamos National Laboratory and Comparison With Most Stringent Regulations or Guidelines—No Action (2005)

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	7,689 ^a	115
	1-hour	11,578 ^a	630
Lead	Calendar Quarter	1.5 ^b	<0.01
Nitrogen dioxide	Annual	73 ^a	3.8
	24-hour	145 ^a	^c
Ozone	1-hour	235 ^b	^d
Particulate matter	Annual	50 ^b	8
	24-hour	150 ^b	21
Sulfur dioxide	Annual	40 ^a	1.3
	24-hour	202 ^a	^c
	3-hour	1,300 ^b	^c
Mandated by New Mexico			
Hydrogen sulfide	1-hour	11 ^a	^c
Total reduced sulfur	30-minute	3 ^a	^c
Total suspended particulates	Annual	60 ^a	8
	30-day	90 ^a	<21
	7-day	110 ^a	<21
	24-hour	150 ^a	21
Hazardous and Other Toxic Compounds			
Acetic acid	8-hour	250 ^a	2.87
Ammonia	8-hour	180 ^a	4.27
2-Butoxyethanol	8-hour	1,200 ^a	0.66
Chloroform	8-hour	^e	2.61
Ethyl acetate	8-hour	14,000 ^a	0.44
Ethylene glycol	8-hour	^e	0.39
Formaldehyde	8-hour	^e	0.24
Heptane (N-heptane)	8-hour	^e	9.06
Hexane (N-hexane)	8-hour	^e	0.41
Hydrogen chloride	8-hour	^e	3.41
Hydrogen fluoride	8-hour	^e	1.29
Isopropyl alcohol	8-hour	9,800 ^a	2.88
Kerosene	8-hour	^e	1.27
Methyl alcohol	8-hour	^e	3.14
Methyl ethyl ketone	8-hour	^e	9.95
Methylene chloride	8-hour	^e	5.90
Nickel	8-hour	10 ^a	0.27
Nitric acid	8-hour	50 ^a	3.53
Nitrogen oxide	8-hour	^e	2.29
Propane sulfone	8-hour	400 ^a	1.00
Stoddard solvent	8-hour	5,250 ^a	1.41
Toluene	8-hour	^e	13.26

Table 4.2.8.3-1. Estimated Operational Concentrations of Pollutants at Los Alamos National Laboratory and Comparison With Most Stringent Regulations or Guidelines—No Action (2005)—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)
Hazardous and Other Toxic Compounds (continued)			
Tungsten (as W) (insoluble)	8-hour	50 ^a	0.53
1,1,2-Trichloroethane	8-hour	^c	4.95
Trichloroethylene	8-hour	^c	1.12
VM&P naphtha	8-hour	13,500 ^a	3.27
Xylene	8-hour	^c	9.41

^a State standard or guideline. The conversion from ppm to mg/m^3 for ambient air quality standards is calculated with the corrections for temperature (21 °C) and pressure (elevation) (2,250 m MSL).

^b Federal standard.

^c No monitoring data available, concentration assumed less than applicable standard.

^d Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

^e No State standard for indicated averaging time.

Source: 40 CFR 50; LANL 1994a; NM EIB 1995a; NM EIB 1996a.

NOISE

The location of the fissile materials storage facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential for onsite and offsite noise impacts. Traffic would occur onsite and along offsite large and regional transportation routes used to bring materials and workers to the site.

Preferred Alternative: No Action Alternative

Nontraffic noise sources associated with continued interim storage and other ongoing missions are the same as described in Section 3.9.3. The continuing operations at LANL would result in no appreciable change from current levels in traffic noise and onsite operational noise. Nontraffic noise sources are located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public due to the size of the site. Some noise sources may result in impacts, such as disturbance of wildlife.

Phaseout

A reduction in noise levels associated with facility operations may result from the phaseout of storage facilities.

4.2.8.4 Water Resources

Impacts associated with the No Action and phaseout of Pu storage facilities at LANL would not affect water resources. The vast majority of water used at LANL would be to continue to be supplied by three DOE-owned well fields. Wastewater would continue to be discharged to Los Alamos, Sandia, and Mortandad Canyons. Table 4.2.8.4–1 presents No Action water resources uses and discharges and the potential changes to water resources at LANL resulting from phaseout.

Table 4.2.8.4–1. No Action and Potential Changes to Water Resources at Los Alamos National Laboratory—No Action (2005) and Storage Phaseout

Affected Resource Indicator	No Action	Phaseout
Water Source	Ground	Ground
Construction		
<i>Water Availability and Use</i>		
Total water requirements (million l/yr)	NA ^a	0
Percent increase in projected water usage ^b	NA ^a	0
<i>Water Quality</i>		
Total wastewater discharge (million l/yr)	NA ^a	0
Percent change in wastewater discharge ^c	NA ^a	0
Operation		
<i>Water Availability and Use</i>		
Total water requirements (million l/yr)	5,760 ^a	0
Percent increase in projected water usage ^d	0	0
<i>Water Quality</i>		
Total wastewater discharge (million l/yr)	693	0
Percent change in wastewater discharge ^e	0	0
Floodplain		
Is action in 100-year floodplain?	No	No
Is critical action in 500-year floodplain?	No	No

^a See operations section of table for No Action water data.

^b Percent increase in projected water usage during phaseout at LANL is calculated by dividing No Action water requirements (5,760 million l/yr) with that for storage phaseout (0 l/yr).

^c Percent change in wastewater discharge during phaseout at LANL is calculated by dividing No Action water discharges (693 million l/yr) with that for storage phaseout (0 l/yr).

^d Percent increase in projected water usage during operation at LANL is calculated by dividing No Action water requirements (5,760 million l/yr) with that for storage phaseout (0 l/yr).

^e Percent change in wastewater discharge during operation at LANL is calculated by dividing No Action water discharges (693 million l/yr) with that for storage phaseout (0 l/yr).

Note: NA=not applicable.

Source: LANL 1995b:1.

Preferred Alternative: No Action Alternative

Surface Water. A description of the activities that would continue at LANL is provided in Section 3.9. For No Action, treated wastewater discharged to Los Alamos, Sandia, and Mortandad Canyons is expected to remain at 693 million l/yr (183 million gal/yr). No surface water would be withdrawn for drinking water or facility operations.

Groundwater. Under this alternative, minimal impacts to groundwater resources are anticipated. Groundwater withdrawals are expected to increase from 5,519 million l/yr to 5,760 million l/yr (1,460 million gal/yr to 1,520 million gal/yr). No additional impacts to groundwater quality are expected because there are no direct discharges to groundwater.

Phaseout

Phaseout of Pu storage at LANL would not involve any new construction. Because existing facilities are not located in the 100- or 500-year floodplains, phaseout would not affect floodplains.

Surface Water. The phaseout would not result in an incremental change in the total wastewater volume handled at LANL. No impacts to flow or water quality of the receiving canyons would occur. There would be no impact to surface waters from phaseout activities.

Groundwater. The phaseout would not result in an incremental change in the total volume of groundwater withdrawn at LANL. No impacts to groundwater availability would occur. A minor beneficial impact on groundwater resources would occur due to the lessened potential for degradation of water quality. Spill protection systems and plans exist to contain and minimize effects of releases of hazardous substances during phaseout activities. Given normal safeguards and procedures, no impact to groundwater quality would be expected to result from activities associated with the phaseout of Pu storage functions at LANL.

4.2.8.5 Geology and Soils

Impacts to the geologic and soil resources occur during, or as a result of, ground-disturbing activities. LANL is considered only for the No Action Alternative and under the phaseout process. As discussed below, neither of these activities involves new construction and therefore would have no effect on geologic and soil resources at the site.

Preferred Alternative: No Action Alternative

Under the No Action Alternative, DOE would continue current and ongoing activities at LANL. There would be no new ground-disturbing activities beyond those already associated with existing and future site improvements. Because no new construction (associated with this program) or associated ground disturbance for potential soil erosion would occur, the No Action Alternative would have no effect on geologic or soil resources at the site.

Phaseout

The phaseout of storage capacity would have no apparent effects on the geology. However, phaseout could result in beneficial effects on the soils of the area. Hazardous, radioactive and mixed waste sources would be reduced or eliminated from the area, thus decreasing the potential for future soil contamination.

4.2.8.6 Biological Resources

Preferred Alternative: No Action Alternative

The Pu storage mission described in Section 2.2.8 would continue at LANL. This would result in no appreciable change in current conditions of biological resources at LANL as described in Section 3.9.6.

Phaseout

Pu materials at LANL would be phased out of operation. The phaseout of Pu storage facilities is not expected to affect biological resources, although increased human activity could temporarily disturb some wildlife species in the vicinity of the site.

4.2.8.7 Cultural and Paleontological Resources

Preferred Alternative: No Action Alternative

Under this alternative, DOE would continue the existing and planned mission at LANL. This includes continued storage of Pu material in the upgraded NMSF in stabilized forms pursuant to DNFSB Recommendation 94-1. Any impacts to cultural or paleontological resources from these missions would be independent of the proposed action and would be addressed through separate NHPA, *American Indian Religious Freedom Act*, and *Native American Graves Protection and Repatriation Act* regulatory compliance procedures.

Phaseout

For this alternative, all Pu materials at LANL within the scope of this PEIS would be transferred to another site and the storage mission would be phased out. Impacts to prehistoric resources are not anticipated because phaseout is not expected to result in ground-breaking activity. None of the formations within LANL are known to be fossiliferous, so no effects to paleontological resources are expected either. Phaseout may affect, through alteration, if subsequently proposed, some of the historic structures at LANL that have been identified as NRHP-eligible. Native American resources are not expected to be affected.

4.2.8.8 Socioeconomics

Preferred Alternative: No Action Alternative

Regional Economy Characteristics. Total employment in the REA is projected to increase less than 2 percent annually between 1995 and 2000, reaching 122,000 in the latter year. Long-range projections indicate slower growth after the year 2000, when employment would increase over 1 percent annually and reach approximately 179,300 persons in 2040. Unemployment in the REA was 6.2 percent in 1994 and is expected to remain at this level into the near future. Per capita income is projected to increase from approximately \$18,259 in 1995 to \$29,221 in 2040. Projections for the No Action Alternative are presented in Table L-73.

Population and Housing. Population in the ROI is projected to increase from approximately 169,900 in 1995 to 272,000 by 2040. The total number of housing units in the ROI is projected to increase from about 71,100 in 1995 to 113,900 in 2040. Population and housing projections for the No Action Alternative are presented in Tables L-74 and L-75, respectively.

Community Services. Education, public safety, and health care characteristics are used to assess the level of community services in the LANL ROI. School enrollments are projected to increase from about 26,310 students in 1995 to 42,130 students by 2040. The current student-to-teacher ratio is 17.3:1. To maintain this level of service, the number of teachers in the ROI would need to increase from approximately 1,518 in 1995 to 2,431 in 2040. These projections are presented in Tables L-76 and L-77.

The projected numbers of sworn police officers and firefighters serving in ROI communities over the period 1995 to 2040 are shown in Tables L-78 and L-79, respectively. Under No Action, the number of sworn police officers is projected to increase from approximately 267 in 1995 to 428 in 2040 to maintain the current service level of 1.6 sworn officers per 1,000 persons. The number of firefighters in the ROI would need to increase from about 800 in 1995 to 1,280 in 2040 to maintain the present service level of 4.7 firefighters per 1,000 persons.

Hospital occupancy rates are based on current capacity. These rates and the estimated number of practicing physicians serving the ROI population between 1995 and 2040 are presented in Tables L-80 and L-81, respectively. Hospital occupancy rates are projected to increase from approximately 32 percent in 1995 to 51 percent in 2040. To maintain the current physician-to-population ratio of 1.9 per 1,000 persons, the total number of physicians in the ROI would need to increase from approximately 316 in 1995 to 506 in 2040.

Local Transportation. Any increases in traffic would be due to projected growth in the area unrelated to DOE activities. The only alternative considered at LANL is Phaseout which involves no change in employment. Since there would be no impacts, modeling was not performed.

Phaseout

Phasing out of Pu storage at LANL would result in no loss of jobs in the REA. Workers currently employed in this storage area would be relocated to other areas. Thus, the socioeconomic effects for Phaseout would be the same as discussed under No Action (Socio 1996a).

4.2.8.9 Public and Occupational Health and Safety

Assessments have been made of potential radiological and chemical impacts associated with the No Action Alternative at LANL. A discussion of reduced impacts associated with the phaseout of existing Pu storage is also presented. Summaries of radiological impacts from normal operations are presented in Tables 4.2.8.9–1 and 4.2.8.9–2 for the public and workers, respectively. Impacts from hazardous chemicals are presented in Table 4.2.8.9–3. Impacts associated with postulated accidents are addressed in this section.

Preferred Alternative: No Action Alternative

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the current sitewide mission including interim storage of Pu at LANL. The section describes the impacts from normal operation, then describes the potential risks of impacts from facility accidents.

The impacts on the public and on workers under the No Action Alternative during normal operation at LANL would be within applicable regulatory limits.

Normal Operation. The current mission at LANL, where Pu is in interim storage, is described in Section 3.9. The site has identified those facilities that will continue to operate under the No Action Alternative, including interim Pu storage facilities. Radiological and chemical impacts on the public and workers at LANL are described below.

Radiological Impacts. The calculated annual dose to the average and maximally exposed members of the public, the associated fatal cancer risks to these individuals from 50 years of total site operation, the dose to the population within 80 km (50 mi) from total site operation in the year 2030, and the projected number of fatal cancers in this population from 50 years of operation are presented in Table 4.2.8.9–1 under this alternative at LANL. The annual dose of 6.5 mrem to the MEI is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. The annual dose of 2.7 person-rem to the population would be within the limit in proposed 10 CFR 834. To put operational dose impacts into perspective, comparisons with doses from natural background radiation are included in the table.

The Pu storage component of the No Action Alternative is not expected to contribute to public impacts since the radiological releases from storage are anticipated to be virtually zero.

The average annual dose to a site worker and the associated risk of fatal cancer from 50 years of total site operations, and the annual dose to the total site workforce and the projected number of fatal cancers from 50 years of total site operations, are presented in Table 4.2.8.9–2 for the No Action Alternative at LANL.

Hazardous Chemical Impacts. Hazardous chemical impacts on the public resulting from the normal operation under No Action at LANL are presented in Table 4.2.8.9–3. The noncancerous health effects expected and the risk of cancer due to the total chemical exposures, must be estimated for each site. Since the major releases due to normal operation at LANL would make up nearly all of the exposures to onsite workers and to the public in adjacent communities, contributions to the hazardous chemical concentrations from all other sources, for example, industrial operations, are considered negligible for purposes of risk calculations.

The HI for the MEI of the public at LANL resulting from normal operation under the No Action Alternative is 3.0×10^{-2} , and the cancer risk is 5.2×10^{-6} . The HI to the onsite worker is 4.7×10^{-2} , and the cancer risk is 1.5×10^{-4} .

Facility Accidents. Under the No Action Alternative, Pu would continue to be stored at the site in existing facilities. These facilities currently operate in accordance with DOE Orders which ensure that the risk to the public of prompt fatalities due to accidents or cancer fatalities due to operations will be in accordance with the

Table 4.2.8.9–1. Potential Radiological Impacts to the Public During Normal Operation at Los Alamos National Laboratory—No Action

Receptor	No Action
Annual Dose to the Maximally Exposed Individual Member of the Public^a	
Atmospheric release pathway (mrem)	5.7
Drinking water pathway (mrem)	0
Total liquid release pathway (mrem)	0.80
Atmospheric and liquid release pathways combined (mrem)	6.5
Percent of natural background ^b	1.9
50-year fatal cancer risk	1.6×10^{-4}
Population Dose Within 80 Kilometers for Year 2030^c	
Atmospheric release pathways (person-rem)	2.7
Total liquid release pathways (person-rem)	$\sim 0^d$
Atmospheric and liquid release pathway combined (person-rem)	2.7
Percent of natural background ^b	2.8×10^{-3}
50-year fatal cancers	0.068
Annual Dose to the Average Individual Within 80 Kilometers^e	
Atmospheric and liquid release pathways combined (mrem)	9.7×10^{-3}
50-year fatal cancer risk	2.4×10^{-7}

^a The applicable radiological limits for an individual member of the public from site operations are 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway as required by the SDWA; and 100 mrem per year from all pathway combined. Refer to DOE Order 5400.5.

^b The annual natural background radiation level at LANL is 342 mrem for the average individual; the population within 80 km in the year 2030 receives 95,000 person-rem.

^c For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined.

^d Although the maximally exposed individual receives a dose, no population groups are exposed to any liquid pathways.

[Text deleted.]

^e Obtained by dividing the population dose by the number of people projected to live within 80 km of the site in 2030 (278,000).

Note: It is assumed that these doses will not be exceeded in the future under the No Action Alternative. Further, impacts from the Pu storage component of the No Action Alternative are taken to be zero (refer to the text).

Source: LANL 1995s.

Table 4.2.8.9-2. Potential Radiological Impacts to Workers During Normal Operation at Los Alamos National Laboratory—No Action

Receptor	No Action
Involved Workforce^a	
Average worker dose (mrem/yr) ^b	250
50-year risk of fatal cancer	5.0×10^{-3}
Total dose (person-rem/yr)	12.5
50-year fatal cancers	0.25
Noninvolved Workforce^c	
Average worker dose (mrem/yr) ^b	32
50-year risk of fatal cancer	6.4×10^{-4}
Total dose (person-rem/yr)	183
50-year fatal cancers	3.7
Total Site Workforce^d	
Dose (person-rem/yr)	196
50-year fatal cancers	3.9

^a The involved worker is a worker associated with operations of interim Pu storage. It is assumed that there are 50 workers, badged with dosimeters to monitor radiation exposure, with a conservatively estimated average dose of 250 mrem/yr per worker. However, an effective ALARA program will ensure that the exposure will be reduced to that level which is as low as reasonably achievable.

^b The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem/yr (DOE 1992t); the site must make reasonable attempts to maintain doses below this level.

^c The noninvolved worker is a worker onsite but not associated with interim Pu storage operations. The projected number of noninvolved badged workers in 2005, and beyond, is 5,720.

^d The impact to the total workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: DOE 1993n:7.

Table 4.2.8.9-3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation at Los Alamos National Laboratory—No Action

Receptor	No Action
Maximally Exposed Individual (Public)	
Hazard Index ^a	3.0×10^{-2}
Cancer risk ^b	5.2×10^{-6}
Worker Onsite	
Hazard Index ^c	4.7×10^{-2}
Cancer risk ^d	1.5×10^{-4}

^a Hazard Index for MEI: sum of individual Hazard Quotients (noncancerous health effects) for MEI.

^b Cancer risk for MEI=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (slope factor [SF]).

^c Hazard Index for workers: sum of individual Hazard Quotients (noncancerous health effects) for workers.

^d Cancer risk for workers=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237[fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (SF).

Source: Section M.3, Table M.3.4-27.

DOE safety goals. The safety to workers and the public from accidents at existing facilities is also controlled by Technical Safety Requirements specified in detail in a SAR or Basis for Interim Operations document prepared and maintained specifically for a facility or process within a facility. Under these controls, any change in approved operations or to facilities would cause a halt in operations until it can be established that worker and public safety has not been compromised.

Phaseout

Normal Operation. There are virtually no radiological or hazardous chemical releases associated with the storage of Pu at LANL under the No Action Alternative. Therefore, the phaseout of the Pu storage would not result in any impact changes. All workers involved in the removal of Pu from LANL would be monitored to ensure that their doses remain within acceptable levels.

Facility Accidents. The phaseout operation will be conducted in accordance with DOE Orders to ensure that the risk to the public of prompt fatalities due to accidents or of cancer fatalities due to operations will be minimized. For current operations in the facility that would be phased out, the safety of workers and the public from accidents is controlled by Technical Safety Requirements that are specified in SARs or Basis for Interim Operations documents that have been prepared for the facility. Prior to initiating phaseout, the potential for accidents that could impact workers and the public will be assessed and, if necessary, applicable existing safety documentation will be modified to ensure safety for workers and the public.

4.2.8.10 Waste Management

This section summarizes the impacts on wastes management at LANL under No Action and the phaseout of Pu storage. There is no spent nuclear fuel or HLW associated with Pu storage. Table 4.2.8.10-1 lists the projected waste generation rates and treatment, storage, and disposal capacities under No Action for 2005. Projections for No Action were derived from the most recent available environmental data, with appropriate adjustments made for those changing operational requirements where the volume of wastes generated are identifiable. The projection does not include wastes from future, yet uncharacterized, environmental restoration activities. The projections for No Action could change depending on decisions resulting from the PEIS on waste management being prepared by the Department. Facilities that would support the storage of Pu would treat and package all waste generated into forms that would enable staging and/or disposal in accordance with RCRA and other relevant statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated and disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice.

Preferred Alternative: No Action Alternative

Under No Action, TRU, low-level, mixed, hazardous, and nonhazardous wastes would continue to be generated at LANL from the missions outlined in Section 3.9. LANL would continue to treat, store, and dispose of its legacy and newly generated wastes in current and planned facilities. Waste management activities at LANL are categorized as regulatory compliance and project administration, waste minimization, waste treatment, waste storage, and waste disposal. Within each category of waste management activity, various wastes are handled according to waste type as defined by various DOE Orders, as well as Federal and State regulations. Applicable permitting, treatment, storage, and disposal requirements are determined according to these waste types.

Liquid TRU waste would continue to be generated at the Plutonium Facility (TA-55). The residual TRU waste sludge that remains after treatment would continue to be loaded into 208-l (55-gal) steel drums, solidified, and transported to Area G for storage. Solid TRU waste would be characterized, certified to meet the current planning-basis criteria for acceptance at WIPP or an alternative treatment level, and placed in storage at Area G pending decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste and the approval of WIPP as a repository for these wastes pursuant to the requirements of 40 CFR 191 and 40 CFR 268. A new planned facility for characterizing and processing solid TRU waste is projected to be operational in 2006.

Liquid LLW would be neutralized and solidified in two onsite treatment facilities. Depending on decisions from the site-wide EIS, solid LLW would be compacted, packaged, and stored for disposal either in an onsite, expanded Area G LLW burial site or through other disposal options. Liquid mixed waste would undergo neutralization/pH adjustment, oxidation/reduction, precipitation, chelation/flocculation, and filtration. Both liquid and solid mixed waste would be treated and disposed of according to the LANL Site Treatment Plan that was developed pursuant to the *Federal Facility Compliance Act*. The resulting waste would then be stored in a RCRA-permitted facility in DOT-approved containers until it is shipped to an offsite DOE disposal facility. Some of this waste would be placed in interim storage until new technologies for treatment and disposal are identified and evaluated. Liquid sanitary wastes would be treated by a consolidation and collection system and discharged to NPDES permitted sanitary tile fields. Solid nonhazardous waste would be disposed of in a regional commercial disposal facility.

Table 4.2.8.10-1. Projected Waste Management Under No Action (2005) at Los Alamos National Laboratory

Category	Annual Generation (m ³)	Treatment Method	Treatment Capacity (m ³)	Storage Method	Storage Capacity (m ³)	Disposal Method	Disposal Capacity (m ³)
Transuranic							
Liquid	0.1	Pretreatment at TA-50: neutralization, clarification, filtration, precipitation, cement mixing	132,659	NA	NA	NA	NA
Solid	54	Volume reduction	51,989	Storage pads at TA-54, modified LLW burial pits and shafts	24,355	None: Federal repository in the future	None
Mixed							
Transuranic							
Liquid	None	Included in TRU	Included in TRU	NA	NA	NA	NA
Solid	255	Included in TRU	Included in TRU	Included in TRU	Included in TRU	None: Federal repository in the future	None
Low-Level							
Liquid	21,400	Chemical treatment and ion-exchange, solidification; and volume reduction (vial crusher)	45 m ³ /hr	Chemical and Ion-Exchange Plant at TA-50 and the Chemical Plant at TA-21	663	Treatment effluent is discharged to the environment. Residual sludge is solidified and disposed of at TA-54, Area G as solid LLW	None
Solid	2,690	Compaction	76	TA-54 in Area G	Variable	Currently solid LLW goes to TA-54, Area G for burial. Continued construction at Area G under evaluation in the site-wide EIS	24 to 28 ha
Mixed Low-Level							
Liquid	0	Neutralization, precipitation, oxidation, thermal treatment; solidification; volume reduction; liquid scintillation cocktail vials	Capabilities under development per site treatment plan	RCRA-permitted bldgs. (not built yet) and interim status container storage areas	583	NA	None

Table 4.2.8.10-1. Projected Waste Management Under No Action (2005) at Los Alamos National Laboratory—Continued

Category	Annual Generation (m ³)	Treatment Method	Treatment Capacity (m ³)	Storage Method	Storage Capacity (m ³)	Disposal Method	Disposal Capacity (m ³)
Solid	45	None	Capabilities under development per site treatment plan	TA-54, Area L, or G	1,864	Capabilities under development as per Site Treatment Plan for Mixed Wastes	None
Hazardous							
Liquid	273	Thermal treatment, treatment tanks, neutralization, and precipitation, and evaporation	Varies depending on the waste stream	Thermal treatment TAs-14, -15, -16, -36, and -39 and storage and treatment at TA-54, Area L	502	Offsite	NA
Solid	669	Thermal treatment and flashpad	Varies depending on the waste stream	Thermal treatment TAs-14, -15, -16, -36, and -39 and storage and treatment at TA-54, Area L	502	Offsite	NA
Nonhazardous (Sanitary)							
Liquid	692,827	Filtration, settling, and stripping	1,060,063	NA	NA	Permitted discharge sanitary tile fields	2,271,240 liters/day
Solid	5,453	None	None	NA	NA	Offsite county landfill and onsite landfill Area J	NA
Nonhazardous (Other)							
Liquid	Included in sanitary	See sanitary	Included in sanitary	NA	NA	See sanitary	Included in sanitary
Solid	Included in sanitary	None	None	NA	NA	See sanitary	NA

Note: NA=not applicable.

Source: LANL 1990a; LANL 1994b.

Phaseout

Upgrades to facilities at the site may be required in order to ensure compliance with all applicable Federal and State laws, DOE Orders, and standing agreements during the transition. The small amount of waste associated with Pu storage would no longer be generated.



**Office of
Fissile Materials Disposition**

United States Department of Energy

**Storage and Disposition of
Weapons-Usable Fissile Materials
Final Programmatic Environmental
Impact Statement**

Volume II - Part B

December 1996

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U.S. Department of Energy

Office of Fissile Materials Disposition, 1000 Independence Ave., SW, Washington, DC 20585

COVER SHEET

RESPONSIBLE AGENCY: U.S. Department of Energy (DOE)

TITLE: *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (DOE/EIS-0229)*

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ABSTRACT: This document analyzes the potential environmental consequences of alternatives for the long-term storage (up to 50 years), including storage until disposition, and disposition of weapons-usable fissile materials from U.S. nuclear weapon dismantlements under the responsibility of the DOE. Long-term storage of nonsurplus inventories of weapons-usable plutonium (Pu) and highly enriched uranium (HEU) are required for national defense purposes, while the disposition of surplus weapons-usable Pu is necessary in order to implement our national nonproliferation policy. In addition to the No Action Alternative, this PEIS assesses three storage alternatives (that is, upgrade at multiple sites, consolidation of Pu, and collocation of Pu and HEU) at six DOE candidate sites located across the country. These sites are Hanford Site, Nevada Test Site, Idaho National Engineering Laboratory, Pantex Plant, Oak Ridge Reservation, and Savannah River Site. Although they are not candidate sites for storage, Rocky Flats Environmental Technology Site (RFETS) and Los Alamos National Laboratory are assessed for the No Action Alternative. For the disposition of surplus Pu, three alternative categories (that is, deep borehole, immobilization, and reactor) with nine primary alternatives are assessed at several DOE and representative sites for analysis purposes. Evaluations of impacts on site infrastructure, water resources, air quality and noise, socioeconomic, waste management, public and occupational health and safety, and environmental justice are included in the assessment. The intersite transportation of nuclear and hazardous materials is also assessed. DOE's Preferred Alternative is identified in this Final PEIS. The Preferred Alternative for storage is a combination of No Action and Upgrade Alternatives for the various DOE sites, and phaseout of Pu storage at RFETS. The Preferred Alternative for disposition of surplus Pu is to pursue a disposition strategy involving a combination of immobilization and reactor alternatives, including vitrification, ceramic immobilization, and existing reactors.

PUBLIC INVOLVEMENT: The DOE issued a Draft PEIS on March 8, 1996, and held a formal public comment period on the Draft through June 7, 1996. In preparing the Final PEIS, DOE considered comments received via mail, fax, electronic bulletin board (Internet), and transcripts of messages recorded by telephone. In addition, comments and concerns were recorded by notetakers during interactive public meetings held during March and April 1996 in Denver, CO, Las Vegas, NV, Oak Ridge, TN, Richland, WA, Idaho Falls, ID, Washington, DC, Amarillo, TX, and North Augusta, SC. Comments received and DOE's responses to those comments are found in Volume IV of the Final PEIS.

FOREWORD

This is the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (PEIS), prepared by the U.S. Department of Energy, Office of Fissile Materials Disposition. The document is composed of four volumes and a separate Summary. Changes made since the Draft PEIS are shown by change bar notation (vertical lines adjacent to the changes) in this Final PEIS for both text and tables. Deletion of one or more sentences is indicated by the phrase "Text deleted." in brackets. This Final PEIS includes the Preferred Alternative, which is a combination of alternatives. The Preferred Alternative is described in Section 1.6 and Chapter 2 of Volume I, and analyzed in Chapter 4 of Volume II. For all the alternatives, including the Preferred Alternative, a comparison of alternatives is presented in Section 2.5 of Volume I and a summary of impacts is presented in Section 4.6 of Volume II (Part B). Information from these sections is also presented in the Summary.

Volume I contains Chapters 1 through 3 of the PEIS. Chapter 1 includes a description of the history and background of the fissile materials disposition program, the purpose of and need for the proposed action, a summary of changes made to the Draft PEIS, and the Preferred Alternative. Chapter 2 gives a description of the proposed long-term storage and disposition alternatives, a description of how the alternatives were selected and why others were eliminated from further consideration, and a comparison of the alternatives in terms of their potential environmental impacts. Chapter 3 describes the affected environment at candidate long-term storage locations, and at sites and environmental settings for the disposition alternatives.

Volume II (Parts A and B) contains Chapters 4 through 10 of the PEIS. Chapter 4 describes the potential environmental impacts resulting from construction and operation of the proposed long-term storage and disposition alternatives, including the Preferred Alternative. Also contained in this chapter are intersite transportation impacts, a discussion of environmental justice issues, cumulative impacts due to the implementation of the proposed alternatives in addition to other actions at a site, avoided environmental impacts, and a summary of impacts. Chapter 5 provides a list of references used in the preparation of this document. Chapter 6 provides an index to the main text of the PEIS. Chapter 7 is a glossary of key terms used in the document. Chapter 8 is a list of preparers. Chapter 9 lists government agencies and organizations contacted during the preparation of this PEIS. Chapter 10 provides a distribution list for the document.

Volume III contains the appendices to this PEIS. Appendix A contains the fact sheet on the President's *Nonproliferation and Export Control Policy*, and the Joint Statement Between the United States and Russia on Nonproliferation. Appendix B provides specifications for key buildings within each facility complex analyzed in this PEIS. Appendix C describes requirements for construction and operation of the various facilities required to accomplish the storage and disposition activities essential to the alternatives described in this PEIS. Appendix D provides information on overall water usage for the storage and disposition facilities discussed in this PEIS. Appendix E gives a general overview of the Department of Energy (DOE) environmental restoration and waste management program, baseline waste management at DOE sites, and project-specific waste management activities associated with the proposed long-term storage and disposition alternatives. Appendix F provides detailed data supporting the air quality and noise analyses. Appendix G describes the methodology used for intersite transportation risk analysis and provides a summary of hazardous materials shipped to and from DOE sites, plus information on shipping containers. Appendix H evaluates various plutonium waste forms for potential disposal in a high-level waste repository. Appendix I describes operations of a Canadian Deuterium Uranium Reactor. Appendix J identifies the compliance requirements associated with the Proposed Action, as specified by the major Federal and State environmental, safety, and health statutes, regulations, and orders. Appendix K lists the scientific names of common nonthreatened and nonendangered animal and plant species identified in Chapters 3 and 4. Appendix L includes the supporting data used for assessing the No Action

Alternative in the socioeconomics sections of this PEIS. Appendix M presents detailed information on the potential health risks associated with releases of radioactivity and hazardous chemicals from the proposed storage and disposition alternatives during normal operations and from postulated accidents. Appendix N describes different concepts for, and provides cost and benefit information on, the multipurpose reactor. Appendix O provides a description of facilities and operations for a can-in-canister approach to plutonium immobilization at the Savannah River Site in South Carolina. Appendix P describes the potential environmental impacts of using the Manzano Weapons Storage Area in New Mexico for the long-term storage of plutonium pits. Appendix Q identifies the potential health impacts from the storage of Rocky Flats Environmental Technology Site plutonium pits at the Pantex Plant in Texas. Appendix R discusses the aircraft crash and radioactive release probabilities for proposed storage and disposition facilities at Pantex Plant in Texas. A separate Classified Appendix was also prepared, which provides detailed analysis results for intersite transportation risks based on classified inventories of materials stored at DOE sites.

Volume IV (Parts A and B) is the Comment Response Document. It contains an overview of the public comment process, the comments received on the Draft PEIS during the public review period, and the DOE responses to those comments, including identifying changes made to the Draft PEIS in response to public comments.

The Summary provides a brief overview of the PEIS. It includes the purpose of and need for the Proposed Action, a description of the storage and disposition alternatives including the Preferred Alternative, and the potential environmental impacts resulting from these alternatives.

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LIST OF ACRONYMS AND ABBREVIATIONS

AADT	Average Annual Daily Traffic
ACEC	Area of Critical Environmental Concern
ACGIH	American Conference of Governmental Industrial Hygienists
AEA	<i>Atomic Energy Act</i>
AEC	Atomic Energy Commission
AGV	automated guided vehicle
ALARA	as low as reasonably achievable
ALE	Arid Lands Ecology Reserve
ANL-W	Argonne National Laboratory-West
APSF	Actinide Packaging and Storage Facility
AQCR	Air Quality Control Region
ARA	Auxiliary Reactor Area
ARIES	Advanced Recovery and Integrated Extraction System
BEA	Bureau of Economic Analysis
BEIR	biological effects of ionizing radiation
BLM	Bureau of Land Management
BOP	balance-of-plant
BPA	Bonneville Power Administration
BWR	boiling water reactor
CAA	<i>Clean Air Act</i>
CANDU	Canadian deuterium uranium
CAS	Chemical Abstracts Service
CCDF	complimentary cumulative distribution function
CEQ	Council on Environmental Quality
CERCLA	<i>Comprehensive Environmental Response, Compensation, and Liability Act</i>
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CGTO	Consolidated Group of Tribes and Organizations
CI	confidence interval
CIC	can-in-canister
CLUP	Comprehensive Land-Use Plan
CMR	Chemistry and Metallurgy Research

COE	Corps of Engineers
Complex	Nuclear Weapons Complex
CRD	Comment Response Document
CRT	Cargo Restraint Transporters
CWA	<i>Clean Water Act</i>
D&D	decontamination and decommissioning
DAF	Device Assembly Facility
DCG	derived concentration guide
DHLW	defense high-level waste
DNB	departure of nucleate boiling
DNFSB	Defense Nuclear Facilities Safety Board
DNL	day and night average sound levels
DNWR	Desert National Wildlife Range
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DP	Office of Defense Programs
DRCOG	Denver Regional Council of Governments
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EBR	Experimental Breeder Reactor
EDNA	Environmental Design for Noise Abatement
EIA	Energy Information Administration
EIS	environmental impact statement
EM	Office of Environmental Management
EPA	Environmental Protection Agency
ERR	excess relative risk
ES&H	Office of Environment, Safety, and Health
ESA	<i>Endangered Species Act</i>
ETF	effluent treatment facility
FAIR	Forest, Agriculture, Industry, and Research
FCF	Fuel Cycle Facility
FEMA	Federal Emergency Management Agency
FFCA	Federal Facility Compliance Agreement
FFTF	Fast Flux Test Facility

FLPMA	<i>Federal Land Planning Management Act</i>
FMEF	Fuels and Materials Examination Facility
FMF	Fuel Manufacturing Facility
FONSI	Finding of No Significant Impact
FR	Federal Register
FSAR	Final Safety Analysis Report
GBZ	Glass-bonded zeolite
GESMO	Generic Environmental Statement on Mixed Oxide
GIS	Geographical Information System
GMA	<i>Growth Management Act</i>
GMODS	Glass Material Oxidation Dissolution System
HAD	hazard analysis document
Hanford	Hanford Site
HE	high explosives
HEAST	Health Effects Summary Table
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HEU EIS	<i>Disposition of Surplus Highly Enriched Uranium Environmental Impact Statement</i>
HFEF	Hot Fuel Examination Facility
HI	Hazard Index
HLW	high-level waste
HQ	Hazard Quotient
HRA EIS	<i>Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan</i>
HVAC	Heating Ventilation and Air Conditioning
HWR	Heavy Water Reactor
IAEA	International Atomic Energy Agency
ICPP	Idaho Chemical Processing Plant
ICRP	International Commission of Radiological Protection
INEL	Idaho National Engineering Laboratory
IRIS	Integrated Risk Information System
ISCST2	Industrial Source Complex Short-Term Model Version 2
ISO	International Standards Organization
IWG	Interagency Working Group
K-25	K-25 Site

L/ER	Energy Research Program Office
LA	Limited Area
LAA	Limited Access Area
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Scattering Center
LCF	latent cancer fatalities
LDR	Land Disposal Restriction
LEU	low-enriched uranium
LIGO	Laser Interferometer Gravitational-Wave Observatory
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LOB	Laboratory Office Building
LWR	Light Water Reactor
MAA	Material Access Area
MACCS	Melcor Accident Consequence Code System
MC&A	Material Control and Accountability
MD	Office of Fissile Materials Disposition
MEI	maximally exposed individual
MHR	Modular Helium Reactor
MMI	Modified Mercalli Intensity
MOX	mixed oxide
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NAGPRA	<i>Native American Graves Protection and Repatriation Act</i>
NAS	National Academy of Sciences
NCDC	National Climatic Data Center
NCRP	National Commission of Radiological Protection
NEIC	National Earthquake Information Center
NEPA	<i>National Environmental Policy Act</i>
NERP	National Environmental Research Park
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFS	Nuclear Fuel Services Fuel Fabrication Plant
NHPA	<i>National Historic Preservation Act</i>
NIOSH	National Institute of Occupational Safety and Health
NMSF	Nuclear Material Storage Facility

NMSM	Nuclear Materials and Stockpile Management
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NRF	Naval Reactors Facility
NRHP	National Register of Historic Places
NTS	Nevada Test Site
NTS EIS	<i>Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada</i>
NWI	National Wetlands Inventory
NWPA	<i>Nuclear Waste Policy Act</i>
NWS	National Weather Service
OCRWM	Office of Civilian Radioactive Waste Management
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
PA	Protected Area
Pantex	Pantex Plant
Pantex EIS	<i>Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components</i>
PBF	Power Burst Facility
PCV	Primary Containment Vessel
PEIS	programmatic environmental impact statement
PEL	Permissible Exposure Level
PFP	Plutonium Finishing Plant
PFP EIS	<i>Plutonium Finishing Plant Stabilization Environmental Impact Statement</i>
PIDAS	Perimeter Intrusion Detection and Alarm System
PNNL	Pacific Northwest National Laboratory
PPA	Property Protection Area
PRA	probabilistic risk assessment
PSAR	Preliminary Safety Analysis Report
PSD	Prevention of Significant Deterioration

PUREX	Plutonium-Uranium Extraction Plant
PWR	pressurized water reactor
R&D	Research and Development
RCRA	<i>Resource Conservation and Recovery Act</i>
REA	regional economic area
RIA	reactivity insertion accident
RFETS	Rocky Flats Environmental Technology Site
RIMS II	Regional Input-Output Modeling System
RL	Richland Operations Office
ROD	Record of Decision
ROI	region of influence
RSWF	Radioactive Scrap and Waste Facility
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
SAR	Safety Analysis Report
SARA	<i>Superfund Amendments and Reauthorization Act</i>
sd	standard deviation
SDWA	<i>Safe Drinking Water Act</i>
SEB	Security Equipment Building
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SISMP	Site Integrated Stabilization and Management Plan
SMR	Standardized Mortality Ratio
SNF	spent nuclear fuel
SNL	Sandia National Laboratories
SRR	standardize rate ratio
SRS	Savannah River Site
Stockpile Stewardship and Management PEIS	<i>Programmatic Environmental Impact Statement for Stockpile Stewardship and Management</i>
Storage and Disposition PEIS	<i>Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement</i>
SST	safe secure trailer
START	Strategic Arms Reduction Talks

TA	Technical Area
TAN	Test Area North
TCLP	toxicity characteristic leaching procedure
TDEC	Tennessee Department of Environmental Conservation
TDS	total dissolved solids
TI	transport index
TLV	Threshold Limit Values
TNRCC	Texas Natural Resources Conservation Commission
TRA	Test Reactor Area
TRU	transuranic
TSCA	<i>Toxic Substance Control Act</i>
TSD	Transportation Safeguards Division
TSP	total suspended particulates
TSR PEIS	<i>Tritium Supply and Recycling Programmatic Environmental Impact Statement</i>
TVA	Tennessee Valley Authority
USFWS	United States Fish and Wildlife Services
USGS	United States Geological Survey
VOC	volatile organic compound
VRM	Visual Resource Management
WAC	Waste Acceptance Criteria
Waste Management PEIS	<i>Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste</i>
WIPP	Waste Isolation Pilot Plant
WMIS	Waste Management Information System
WNP	Washington Nuclear Power
WPPSS	Washington Public Power Supply System
WSA	Weapons Storage Area
WSCC	Western Systems Coordinating Council
WSCF	Waste Sampling and Characterization Facility
Y-12	Y-12 Plant
Y-12 EA	<i>Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Level at the Y-12 Plant, Oak Ridge, Tennessee</i>
YMSCO	Yucca Mountain Site Characterization Office
ZPPR	Zero Power Physics Reactor

CHEMICALS AND UNITS OF MEASURE

°C	degrees Celsius
Ci	curie
cm	centimeter
CO	carbon monoxide
CO ₂	carbon dioxide
Co-60	cobalt-60
Cs	cesium
Cs-137	cesium-137
CsCl	cesium chloride
Cu	copper
dB	decibel
dBA	decibel A-weighted
°F	degrees Fahrenheit
ft	feet
ft ²	square feet
ft ³	cubic feet
g	gram
G	gravitational acceleration
gal	gallon
Gd	gadolinium
GWd	gigawatt-days
ha	hectare
H ₂	hydrogen
HF	hydrogen fluoride
HNO ₃	nitric acid
hr	hour
I-129	iodine-129
in	inch
k _{eff}	effective neutron multiplication factor
kg	kilogram
km	kilometer
km ²	square kilometer

Kr	krypton
kV	kilovolt
l	liter
lb	pound
m	meter
m ²	square meter
m ³	cubic meter
mCi	millicurie
mg	milligram
mi	mile
mi ²	square miles
min	minute
mph	miles per hour
mrem	millirem (one thousandth of a rem)
MW	megawatt
MWe	megawatt electric
N ₂	nitrogen
nCi	nanocurie (one-billionth of a Curie)
Ni	nickel
NO ₂	nitrogen dioxide
NO _x	nitrogen oxides
O ₃	ozone
oz	ounce
Pb	lead
PCB	polychlorinated biphenyl
pCi	picocurie (one-trillionth of a Curie)
PM ₁₀	particulate matter less than or equal to 10 microns
ppm	parts per million
Pu	plutonium
PuCl	plutonium chloride
PuO ₂	plutonium dioxide
rad	radiation absorbed dose
rem	roentgen equivalent man
RfC	Reference Concentration
RfD	Reference Dose

s	second
SO ₂	sulfur dioxide
Sr-90	strontium-90
t	metric ton
Tc-99	technetium-99
ton	short ton
U	uranium
U-233	uranium-233
U-234	uranium-234
U-235	uranium-235
U-236	uranium-236
U-238	uranium-238
UF ₆	uranium hexafluoride
UNH	uranyl nitrate hexahydrate
UO ₂	uranium dioxide
U ₃ O ₈	triuranium octaoxide
VOC	volatile organic compound
yd	yard
yr	year
μg	microgram (one-millionth of a gram)

METRIC CONVERSION CHART

To Convert Into Metric			To Convert Out of Metric		
If You Know	Multiply By	To Get	If You Know	Multiply By	To Get
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
sq. inches	6.4516	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.092903	sq. meters	sq. meters	10.7639	sq. feet
sq. yards	0.8361	sq. meters	sq. meters	1.196	sq. yards
acres	0.40469	hectares	hectares	2.471	acres
sq. miles	2.58999	sq. kilometers	sq. kilometers	0.3861	sq. miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.45360	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

METRIC PREFIXES

Prefix	Symbol	Multiplication Factor
exa-	E	1 000 000 000 000 000 000 = 10^{18}
peta-	P	1 000 000 000 000 000 = 10^{15}
tera-	T	1 000 000 000 000 = 10^{12}
giga-	G	1 000 000 000 = 10^9
mega-	M	1 000 000 = 10^6
kilo-	k	1 000 = 10^3
hecto-	h	100 = 10^2
deka-	da	10 = 10^1
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	μ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}
femto-	f	0.000 000 000 000 001 = 10^{-15}
atto-	a	0.000 000 000 000 000 001 = 10^{-18}

4.3 PLUTONIUM DISPOSITION ALTERNATIVES AND RELATED ACTIVITIES

This section describes the potential environmental impacts associated with the disposition of surplus Pu. A key to locating information on the disposition alternatives for deep borehole, immobilization, and reactors categories; common activities; and sites and environmental setting analyzed is shown in Table 4–2. Pit disassembly/conversion and Pu conversion are activities common to all of the disposition alternatives, while MOX fuel fabrication is an activity common to only the reactor alternatives. All three of these activities are analyzed individually in this section. Because at this programmatic stage of NEPA review and decisionmaking, DOE is analyzing and anticipates selecting a technology strategy and not specific locations or facilities at a specific site, representative and generic sites are used for analysis. The representative DOE sites are Hanford, NTS, INEL, Pantex, ORR, and SRS. Additionally, some disposition alternatives (specifically those involving deep borehole placement, MOX fuel fabrication at a commercial facility, and the use of existing or partially completed reactor facilities) do not lend themselves to specific site analysis at this time. Therefore, generic and representative site characteristics have been used for the environmental analysis of these alternatives and activities. For the CANDU Reactor Alternative, common disposition-related activities in the United States are analyzed in this section. [Text deleted.] A description of operational and key environmental issues regarding the use of CANDU reactors for burning MOX fuel is provided in Appendix I.

4.3.1 PIT DISASSEMBLY/CONVERSION FACILITY

The environmental impacts described in the following sections are based on the analysis of the pit disassembly/conversion facility as described in Section 2.4.1. The representative sites analyzed for this facility are: Hanford, NTS, INEL, Pantex, ORR, and SRS. These sections describe the construction and operational impacts of the pit disassembly/conversion facility on the following potentially affected areas: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, public and occupational health and safety, and waste management.

In accordance with the Preferred Alternative for surplus Pu disposition, the pit disassembly/conversion facility could be located at either Hanford, INEL, Pantex, or SRS. Further tiered NEPA review will be conducted to examine alternative locations including new and existing facilities at these four sites should the Preferred Alternative be selected at the ROD. Although new facilities are analyzed in Section 4.3.1.1 through 4.3.1.10, DOE would preserve the option for using existing facilities to the extent practical pursuant to subsequent tiered NEPA review.

4.3.1.1 Land Resources

At all sites, the pit disassembly/conversion facility would disturb 14 ha (35 acres) of land during construction, of which 12 ha (30 acres) would be used for the operating facility. The facility would be sited in a 1.6-km (1-mi) buffer zone contained within the site boundary except at ORR, where the buffer zone is less than 1.6 km (1 mi). With the 1.6-km (1-mile) buffer zone, total land requirement would be 1,853 ha (4,580 acres). This section describes the construction and operational impacts of the pit disassembly/conversion facility on land resources for each representative site.

As discussed in Section 4.3.1.8, historic housing construction rates at all sites would be sufficient to absorb the increase in population caused by the in-migration of operational workers. No in-migration would occur during construction. No offsite land use would be affected; therefore, no indirect impacts would occur.

Hanford Site

Land Use. The potential site for the pit disassembly/conversion facility would be vacant land in the 200 Area adjacent to 200 East. Construction and operation of the pit disassembly/conversion facility would conform with existing and future land use as described in the current *Hanford Site Development Plan* and with ongoing discussions in the comprehensive land use planning process. According to the *Hanford Site Development Plan*, 200 Area land use is identified as waste operations, which includes radioactive material management, processing, and storage (HF DOE 1993c:13,14). [Text deleted.]

Construction and operation would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. Construction and operation would be consistent with State and local (Benton, Franklin, and Grant Counties and the city of Richland) land-use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction and operation would be consistent with the industrialized landscape character of the 200 Area. Construction and operation would be consistent with the current VRM Class 5 designation.

Nevada Test Site

Land Use. The potential location for the pit disassembly/conversion facility would be on undeveloped land in Area 6 adjacent to the DAF. Construction and operation of the facility in Area 6 would not be in conformance with the current *Nevada Test Site Development Plan*, which designates the southeast area of NTS as a nonnuclear test area. However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as part of the NTS defense program materials disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8—3-9); NT DOE 1996e:A-18.

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, or controls of adjacent jurisdictions since none of these counties or municipalities currently undertake land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. Views of the proposed action would be blocked from sensitive viewpoints accessible to the public by mountainous terrain.

Idaho National Engineering Laboratory

Land Use. The pit disassembly/conversion facility would be located on undeveloped land within the ICPP security area that is part of the central core area/Prime Development Zone of INEL (IN DOE 1992g:12). The potential action would be consistent with the current *Idaho National Engineering Laboratory Site Development Plan*, which designates the future land use of the ICPP as receiving and storing spent nuclear fuels and radioactive wastes (IN DOE 1994d:9-8). [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction and operation would not be in conflict with land use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operation of the facility would be consistent with the existing industrialized landscape character of the ICPP. The alternative would not change the existing VRM Class 5 designation of the area.

Pantex Plant

Land Use. Zone 12 is the potential location for the pit disassembly/conversion facility. The potential action would be consistent with the current *Pantex Site Development Plan* master plan, which designates Zone 12 for weapons assembly/disassembly (PX DOE 1995g:16), although vacant land would be used. [Text deleted.]

Construction and operation would not affect other Pantex or offsite land uses. There would be no impacts to prime farmland. The alternative would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] The visual environment would be consistent with the existing industrialized landscape character. The current VRM Class 5 designation of Zone 12 would not change.

Oak Ridge Reservation

Land Use. The pit disassembly/conversion facility is proposed to be sited on undeveloped land at Y-12. Weapons component manufacturing and development is among the future land uses designated for Y-12 by the future land use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan* (OR DOE 1989a:5-6,5-7). The proposal is compatible with the Plan.

Construction and operation of the pit disassembly/conversion facility would not affect other ORR or offsite land uses. Construction and operation would not be in conflict with the city of Oak Ridge land-use plans, policies, and controls since the current *Oak Ridge Area Land Use Plan* designates the potential site for industrial land use.

Visual Resources. [Text deleted.] The visual environment would be consistent with the existing industrial landscape character. The current VRM Class 5 designation would not change.

Savannah River Site

Land Use. Vacant land in the F-Area would be used for the pit disassembly/conversion facility. The proposed action would conform with existing and future land use as designated by the current *Savannah River Site Development Plan*. According to the Plan, current F-Area land use is designated industrial operations, while the future land-use category is primary industrial mission (SR DOE 1994d:11,12). [Text deleted.]

Construction and operation would not affect other SRS or offsite land uses. There is no prime farmland on SRS. Construction and operation would not be in conflict with land-use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. [Text deleted.] The visual environment would be consistent with the industrial landscape character. The current VRM Class 5 designation of the F-Area would not change.

[Text deleted.]

4.3.1.2 Site Infrastructure

This section discusses the impacts upon site infrastructure needed to support the pit disassembly/conversion facility at each of the six representative sites. Construction and operation of the facility would impact infrastructure at each site differently, depending on current operating resources.

The pit disassembly/conversion facility would consist of a Pu processing structure with shipping and receiving, disassembly and conversion, residue recovery, solid waste treatment, liquid waste treatment, analytical laboratory, and interim storage. The following support facilities would be in adjacent structures: offices, change rooms, central control room, operator training/process demonstration, mechanical shops, emergency generator, warehouse, guard stations, entry portals, and parking. Buildings would be either steel frame/metal skin or concrete construction. For each of the representative sites, Table 4.3.1.2-1 presents infrastructure resources needed annually for construction as well as site availability and consumption without the facility. Comparative impact of average annual resource needs for operation are presented in Table 4.3.1.2-2.

Hanford Site

Resources needed for construction are well within site availability. These resources would represent a small fraction of those needed to operate the site. [Text deleted.] The planned pit disassembly/conversion facility would use natural gas as the primary utility fuel, and the total requirement for natural gas during operations would be higher than the site currently has available. [Text deleted.] The additional amount could be procured through normal contractual means.

Nevada Test Site

Resources needed for construction would be within site availability for everything except oil. The additional oil could be procured through normal contractual means. Operations impacts would be small except for utility fuel. The planned pit disassembly/conversion facility would use natural gas as the primary utility fuel. Since NTS uses fuel oil as its primary utility fuel, use of natural gas in lieu of fuel oil would require additional infrastructure. The final facility design could be converted to use fuel oil. Fuel oil requirements would exceed current site availability, but can be procured through normal contractual means.

Idaho National Engineering Laboratory

Resources needed for construction would be within site availability. The planned pit disassembly/conversion facility would use natural gas as the primary utility fuel. Since INEL does not use natural gas, this facility would be designed to burn fuel oil if INEL were selected as the pit disassembly/conversion facility site.

Pantex Plant

Resources needed for construction would be within site availability. [Text deleted.] Operations impacts would be small. Adequate electrical energy would be available from the regional power grid.

Oak Ridge Reservation

Except for fuel oil, resources required for construction would be within site capacities. Additional fuel oil for construction could be procured through normal contractual means. These resources would represent a small fraction of those needed to operate the site. There would be minimal site infrastructure impacts for operation.

Savannah River Site

Resources needed for construction would be within site availability for everything except oil. The additional oil for construction would be procured through normal contractual means. Operational impacts would be small except for utility fuel and natural gas. The planned pit disassembly/conversion facility would use natural gas as the primary utility fuel. Since SRS uses fuel oil as its primary utility fuel, use of natural gas in lieu of fuel oil would require additional infrastructure. The final facility design would be adapted to use fuel oil. Fuel oil requirements would exceed current site availability, but could be procured through normal contractual means.

Table 4.3.1.2-1. Additional Site Infrastructure Needed for the Construction of the Pit Disassembly/Conversion Facility (Annual)

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	2,500	5	126,200	0	0
Hanford					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage (without facility)	345,500	58	9,334,800	21,039,531	0
Projected usage (with facility)	348,000	63	9,461,000	21,039,531	0
Amount required in excess to site availability	0	0	0	0	0
NTS					
Site availability	176,844	45	5,716,000	0	0
Projected usage (without facility)	124,940	25	5,716,000	0	0
Projected usage (with facility)	127,440	30	5,847,200	0	0
Amount required in excess to site availability	0	0	126,200	0	0
INEL					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage (without facility)	232,500	42	5,820,000	0	11,340
Projected usage (with facility)	235,000	47	5,946,200	0	11,340
Amount required in excess to site availability	0	0	0	0	0
Pantex					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage (without facility)	46,266	10	795,166	7,200,000	0
Projected usage (with facility)	48,766	15	921,366	7,200,000	0
Amount required in excess to site availability	0	0	0	0	0

Table 4.3.1.2-1. Additional Site Infrastructure Needed for the Construction of the Pit Disassembly/Conversion Facility (Annual)—Continued

	Electrical		Oil (l/yr)	Fuel	
	Energy (MWh/yr)	Peak Load (MWe)		Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	2,500	5	126,200	0	0
ORR					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage (without facility)	726,000	110	379,000	95,000,000	16,300
Projected usage (with facility)	728,500	115	505,200	95,000,000	16,300
Amount required in excess to site availability	0	0	89,200 ^a	0	0
SRS					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage (without facility)	794,000	116	28,390,500	0	221,352
Projected usage (with facility)	796,500	121	28,516,700	0	221,352
Amount required in excess to site availability	0	0	126,200 ^a	0	0

^a Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LANL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

Table 4.3.1.2-2. Additional Site Infrastructure Needed for the Operation of the Pit Disassembly/Conversion Facility (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	<5	0	20,000	5	28,000	3,398,000	0
Hanford							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage (without facility)	420	204	345,500	58	9,334,800	21,039,531	0
Projected usage (with facility)	425	204	365,500	63	9,362,800	24,437,531	0
Amount required in excess to site availability	<5	0	0	0	0	3,398,000 ^a	0
NTS							
Site availability	1,100 ^b	0	176,844	45	5,716,000	0	0
Projected usage (without facility)	645	0	124,940	25	5,716,000	0	0
Projected usage (with facility)	650	0	144,940	30	5,744,000	3,398,000	0

**Table 4.3.1.2-2. Additional Site Infrastructure Needed for the Operation of the Pit Disassembly/
Conversion Facility (Annual)—Continued**

	Transportation		Electrical		Fuel		
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	<5	0	20,000	5	28,000	3,398,000	0
Amount required in excess to site availability	0	0	0	0	28,000 ^c	3,398,000 ^a	0
INEL							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage (without facility)	445	48	232,500	42	5,820,000	0	11,340
Projected usage (with facility)	450	48	252,500	47	5,848,000	3,398,000	11,340
Amount required in excess to site availability	<5	0	0	0	0	3,398,000 ^a	0
Pantex							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage (without facility)	76	27	46,266	10	795,166	7,200,000	0
Projected usage (with facility)	81	27	66,266	15	823,166	10,598,000	0
Amount required in excess to site availability	<5	0	0	0	0	0	0
ORR							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage (without facility)	71	27	726,000	110	379,000	95,000,000	16,300
Projected usage (with facility)	76	27	746,000	115	407,000	98,398,000	16,300
Amount required in excess to site availability	<5	0	0	0	0	0	0
SRS							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage (without facility)	230	103	794,000	116	28,390,500	0	221,352
Projected usage (with facility)	235	103	814,000	121	28,418,500	3,398,000	221,352
Amount required in excess to site availability	<5	0	0	0	28,000 ^c	3,398,000 ^a	0

^a Facility would be adapted to use fuel oil instead of natural gas.

^b Includes both paved and unpaved roads.

^c Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LANL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

4.3.1.3 Air Quality and Noise

Construction and operation of the pit disassembly/conversion facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.1.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the pit disassembly/conversion facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM₁₀ and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction.

The pit disassembly/conversion process involves pure Pu materials that would not require chemical processing. The emissions estimates for the facility are based on data from similar processes at LANL's TA-55 facility. The ventilation system for the pit disassembly/conversion facility would be used specifically for contamination control and would use a large volume of air to assure contamination control. Primary confinement would be provided by a glove box system and associated zone air-handling system. There would be four stages of HEPA filters on the glovebox exhaust that would eliminate (or reduce below detection limits) a minimum of 99.95 percent of nonradioactive particulates. Radioactive particulate emissions are discussed in Section 4.3.1.9. The glovebox exhaust would be mixed with room air exhaust, which also has two stages of HEPA filters. The use of HEPA filters would not reduce VOC emissions because VOCs are not in a particulate form. There would also be process-specific scrubbers, vacuum traps, and filters that reduce the chance of criteria or toxic/hazardous pollutants releases from occurring. Because of the processing technology (which does not create some of the criteria pollutants), the defense-in-depth for Pu processing systems, and the extensive HEPA filtration (which removes the remaining criteria pollutants), emissions for criteria pollutants other than VOCs are expected to be below detection limits. VOC emissions of 1,500 kg/yr (3,300 lb/yr) are shown in Table F.1.3-4, and would give trace concentrations at the site boundaries.

NOISE

The location of the facilities associated with pit disassembly/conversion facility relative to the site boundary and sensitive receptors was examined for each of the six sites to evaluate the potential contribution to noise levels

at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Non-traffic noise sources associated with operation of these facilities include ventilation systems, cooling systems, and material handling equipment. These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the sites, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.1.4 Water Resources

The construction and operation of a pit disassembly/conversion facility would affect water resources. Water resource requirements, and discharges provided in Tables C.1.1.2-1 and C.2.1.2-1 and Table E.3.2.1-1 were used to assess impacts to surface and groundwater. A discussion of impacts is provided for each site separately. Table 4.3.1.4-1 presents No Action surface and groundwater uses and discharges at each site, and the potential changes resulting from construction and operation of the pit disassembly/conversion facility.

Hanford Site

Surface Water. Surface water obtained from the Columbia River would be used as the water source for construction and operation of the pit disassembly/conversion facility. During construction, the quantity of water required would be approximately 1.9 million l/yr (0.5 million gal/yr), which represents a 0.01-percent increase over the existing annual surface water withdrawal. These additional withdrawals would cause negligible impacts. During operation, water requirements for the new pit disassembly/conversion facility would be approximately 94.6 million l/yr (25 million gal/yr), which would represent a 0.7-percent increase over the existing surface water withdrawal.

[Text deleted.]

During construction of the pit disassembly/conversion facility, sanitary wastewater (1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to the existing wastewater treatment system at the 200-Area. [Text deleted.] During operation, approximately 85.2 million l/yr (22.5 million gal/yr) of sanitary and other wastewater would be discharged to this wastewater treatment system, then to lined evaporation ponds or recycled. This would represent a 34.6-percent increase in the effluent discharged at Hanford. All discharges would be monitored to comply with discharge requirements.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity, and if uncontaminated, discharged to natural drainage channels or evaporation/infiltration ponds. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity, and if uncontaminated, discharged to storm drains that discharge to local drainage channels.

The pit disassembly/conversion facility would be located in the 200 Area which is above the 100-year, 500-year, and probable maximum floods; flooding from dam failures; and flooding from a landslide resulting in river blockage.

Groundwater. No groundwater would be used for any project-related water requirements; therefore, groundwater availability would not be affected.

No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected. Some stormwater runoff and other discharges routed to storm drains could percolate into the subsurface. These discharges would be monitored and, therefore, no impacts to groundwater quality would be expected.

Nevada Test Site

Surface Water. No surface water would be withdrawn for construction or operation activities associated with the facility; groundwater would be used as the water source for the pit disassembly/conversion facility. Therefore, there would be no impacts to surface water availability.

Table 4.3.1.4-1. Potential Changes to Water Resources Resulting from Pit Disassembly/Conversion Facility

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Water source	Surface	Ground	Ground	Ground	Surface	Ground
No Action water requirements (million l/yr)	13,511	2,400	7,570	249	14,760	13,247
No Action wastewater discharges (million l/yr)	246	82	540	141	2,277	700
Construction						
<i>Water availability and use</i>						
Total water requirement (million l/yr)	1.9	1.9	1.9	1.9	1.9	1.9
Percent increase in projected water use ^a	0.01	0.08	0.03	0.8	0.01	0.01
<i>Water quality</i>						
Total wastewater discharge (million l/yr)	1.9	1.9	1.9	1.9	1.9	1.9
Percent change in wastewater discharge ^b	0.8	2.3	0.4	1.3	0.08	0.3
Percent change in streamflow	neg	NA	NA	NA	0.004 ^c	0.04 ^d
Operation						
<i>Water availability and use</i>						
Total water requirement (million l/yr)	94.6	94.6	94.6	94.6	94.6	94.6
Percent increase in projected water use ^e	0.7	3.9	1.2	38.0	0.6	0.7
<i>Water quality</i>						
Total wastewater discharge (million l/yr)	85.2	85.2	85.2	85.2	85.2	85.2
Percent change in wastewater discharge ^f	34.6	103.9	15.8	60.4	3.7	12.2
Percent change in streamflow	neg	NA	NA	NA	0.2 ^c	1.7 ^d

Table 4.3.1.4-1. Potential Changes to Water Resources Resulting from Pit Disassembly/Conversion Facility—Continued

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Floodplain						
Is action in 100-year floodplain?	No	No	No	No	No	No
Is critical action in 500-year floodplain?	No	Uncertain	Uncertain	No	No	Unlikely
^a Percent increases in water requirements during construction of the pit/disassembly conversion facility are calculated by dividing water requirements for the facility (1.9 million l/yr) with that for No Action water requirements at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr). ^b Percent increases in wastewater discharged during construction of a pit disassembly/conversion facility are calculated by dividing wastewater discharges for the facility (1.9 million l/yr) with that for No Action water requirements at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr). ^c Percent change in stream flow from wastewater discharges is calculated from the average flow of Clinch River (132 m³/s) and East Fork Poplar Creek (1.5 m³/s). The comparison for the East Fork Poplar Creek is shown in the table. ^d Percent change in stream flow from wastewater discharges is calculated from the minimum flow of the Fourmile Branch (0.16 m³/s). ^e Percent increases in water requirements during operation of a pit disassembly/conversion facility are calculated by dividing water requirements for the facility (94.6 million l/yr) with that for No Action water requirements at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr). ^f Percent increases in wastewater discharged during operation of a pit disassembly/conversion facility are calculated by dividing wastewater discharges for the facility (85.2 million l/yr) with that for No Action discharge at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).						

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1995a:1; INEL 1995a:1; LANL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

[Text deleted.]

During construction of the pit disassembly/conversion facility, approximately 1.9 million l/yr (0.5 million gal/yr) of sanitary wastewater would be generated. During operation, approximately 85.2 million l/yr (22.5 million gal/yr) of sanitary and other wastewater would be discharged to a new wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycle.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity, and if uncontaminated, recycled or discharged to local drainage channels. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity, and if uncontaminated, discharged to local drainage channels or be available for recycle.

Because there are no continuously flowing streams on NTS and no designated floodplains, there are no studies to assess the 500-year floodplain boundaries. Studies of the 100-year floodplain showed it to be confined to the Jackass Flats and Frenchman Lake areas. The proposed site for the pit disassembly/conversion facilities is not located in either of these areas. However, since the NTS is in a region where most flooding occurs by locally intense thunderstorms that can create brief (less than 6 hours) flash floods, the facility would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater via the existing supply system. The Lower and Upper Carbonate, the Volcanic, and the Valley-Fill Aquifers are the source of water for operations at NTS.

Total construction water requirements for the facilities (1.9 million l/yr [0.5 million gal/yr]) represent 0.003-percent of the minimum estimated annual recharge to the regional aquifer under the entire NTS. This is based on two studies conducted in recent years which estimated recharge to be 38 to 57 billion l (10 to 15 billion gal) (NT DOE 1992b:41-43; NT USGS 1988a). As shown in Table 4.3.1.4-1, the quantity of water required for construction of the facility represents approximately a 0.08-percent increase over the total projected No Action groundwater usage. Operating the facilities at NTS would require 94.6 million l/yr (25 million gal/yr), which is approximately a 3.9-percent increase in the projected groundwater usage. This additional withdrawal represents a 0.2-percent of the minimum estimated annual recharge. Minimal impacts to groundwater availability would be expected from these additional water withdrawals.

Construction and operation of the pit disassembly/conversion facilities would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward into the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified in the State of Nevada permit. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the pit disassembly/conversion facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the pit disassembly/conversion facility, sanitary wastewater (total of approximately 1.9 million l/yr [0.5 million gal/yr]) would be generated and after treatment discharged to

evaporation/percolation ponds or be available for recycle. During operation, approximately 85.2 million l/yr (22.5 million gal/yr) of sanitary and other wastewater would be generated and handled similarly. All discharges would be monitored to comply with discharge limit.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity, and if uncontaminated, discharged to evaporation/infiltration ponds or to local drainage channels. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity, and if uncontaminated, discharged to local drainage channels or be available for recycle.

The potential site for the new pit disassembly/conversion facilities is not located in an area historically prone to flooding, but is within the flood zone which could occur as a result of the failure of the MacKay Dam during a maximum probable flood. This flood event would be more critical than either the 100- or 500-year flood. Because INEL is in a region where flash floods could occur, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. As shown in Table 4.3.1.4-1, water requirements for operation of the pit disassembly/conversion facility (94.6 million l/yr [25 million gal/yr]) would fall within INEL's current allotment and represent a 1.2-percent increase over the projected annual groundwater usage. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). Construction water requirements for the facility are much less than those for operation. These withdrawals would increase the total site projected amount to be pumped at INEL to 17.8 percent of the allotment during operation. This increase (and that due to construction) should not affect groundwater availability.

Construction and operation of the pit disassembly/conversion facilities would not result in direct discharges to groundwater and would not be expected to contribute to existing near surface contamination. Treated wastewater which does not evaporate, however, could percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Pantex Plant

Surface Water. No surface water would be withdrawn for construction or operation activities associated with the facility; groundwater (or possibly reclaimed wastewater from the Hollywood Road Wastewater Treatment Plant) would be used as the water source for the pit disassembly/conversion facility. Therefore, there would be no impacts to surface water availability.

[Text deleted]

During construction of the pit disassembly/conversion facility, approximately 1.9 million l/yr (0.5 million gal) of sanitary wastewater would be generated and discharged to the existing wastewater treatment systems north of Zone 12. During operation, a maximum of approximately 85.2 million l/yr (22.5 million gal/yr) of sanitary wastewater and other wastewater would be discharged to either of these wastewater treatment systems. After treatment, all wastewater generated during construction and operation would either be discharged to the playa lakes or would be available for recycle. The expected quantity of additional wastewater potentially discharged to the playas (approximately 0.23 million l/day [61,670 gal/day]) should not cumulatively cause any exceedances of the monthly average limit of 2.46 million l/day (650,000 gal/day). This is based on Pantex's

1994 discharges, which averaged approximately 1.4 million l/day (370,000 gal/day) and are expected to decline in the future.

Water from heating the facility will be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity, and if uncontaminated, discharged to playas or local drainage channels. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity, and if uncontaminated, discharged to playas or local drainage channels, or be available for recycle.

The pit disassembly/conversion facility would be located in Zone 12. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in Zone 12, there would be no impacts to flood plains. However, flooding at Pantex could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. All water required for construction and operation would probably be supplied from groundwater using the existing supply system. Construction water requirements for the pit disassembly/conversion facilities are small relative to the recoverable water in aquifer storage, which for the year 2010 was estimated to be 287 trillion l (76 trillion gal) (PX WDB 1993a:1). As shown in Table 4.3.1.4-1, construction of the proposed pit disassembly/conversion facility would require 1.9 million l/yr (0.5 million gal/yr) of water, which represents a 0.8-percent increase over the projected annual groundwater usage and 0.1 percent of the total groundwater system capacity (1,900 million l/yr [502 million gal/yr]). [Text deleted.] Previous studies have shown that when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala Aquifer, an average of 1.8-m/yr (5.9-ft/yr) decline in the water table occurred over a 10-year period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the pit disassembly/conversion facility at Pantex would require 94.6 million l/yr (25 million gal/yr), resulting in a small drawdown. This additional groundwater withdrawal would add to the existing decline in water levels of the Ogallala Aquifer. However, this very small decline would not affect regional groundwater levels and would represent approximately 5.0 percent of the available groundwater. The total site groundwater withdrawal including this facility would be 343.6 million l/yr (90.8 million gal/yr) which, because of expected cutbacks in other programs, would be 59 percent less than the 836 million l/yr (221 million gal/yr) currently being withdrawn from wells at Pantex.

Construction and operation of the new facilities would not result in direct discharges to groundwater. Treated wastewater discharged to playas, could percolate downward into the groundwater of the near surface aquifer. However, water discharged to playas would be monitored and would not be discharged until contaminant levels are within the limits specified by the TNRCC. [Text deleted.]

Although the expected drawdowns caused by withdrawing the water required for this alternative are small, the overall decline in groundwater levels in the Amarillo area is of concern. Possible groundwater conservation measures at Pantex that could be considered including decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Oak Ridge Reservation

Surface Water. Water required for construction and operation of the pit disassembly/conversion facilities would be provided via existing distribution systems. The source of this water is the Clinch River and its tributaries. [Text deleted.] During construction, the total quantity of water required would be approximately 1.9 million l/yr (0.5 million gal/yr), which would represent a 0.01-percent increase over the existing projected annual surface

water withdrawal. This additional withdrawal would cause negligible impacts to surface water availability. During operation, water requirements would be approximately 94.6 million l/yr (25 million gal/yr) annually. This represents a 0.6-percent increase in the projected annual surface water withdrawal and is 0.001-percent of the average flow of the Clinch River ($132 \text{ m}^3/\text{s}$ [$4,647 \text{ ft}^3/\text{s}$]). These additional water withdrawals from the Clinch River would not impact availability.

During construction of the pit disassembly/conversion facilities, sanitary wastewater (total of 1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to the existing wastewater treatment system in the Y-12 area. This would cause a very minor increase in the effluent from this facility. During operation, a total of 85.2 million l/yr (22.5 million gal/yr) of wastewater would be generated by the facility. This would cause a 3.7-percent increase in the effluent discharged from the Y-12 Area. All discharges would be monitored to comply with discharge requirements. Fire sprinkler water and truck hosedown water would be collected in tanks, monitored for radioactivity, and then transferred to a treatment facility as required. Uncontaminated water would be pumped to storm drains.

Since the pit disassembly/conversion facilities would be located outside both the 500- and 100-year floodplains, there would be no impacts to floodplains.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater; therefore, neither groundwater quality nor availability would be affected.

Savannah River Site

Surface Water. No surface water would be used for project requirements during construction or operation of the facility. [Text deleted.] During construction of the pit disassembly/conversion facility, sanitary wastewater (total of 1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to the sitewide wastewater treatment system, which would not require any modifications. This would represent less than a 0.2-percent increase in the effluent from SRS. During operation, approximately 85.2 million l/yr (22.5 million gal/yr) of sanitary wastewater would be discharged to this wastewater treatment system. This would represent a 12.2-percent increase in the effluent discharged from SRS and would be 1.7 percent of Fourmile Branch's minimum flow. Since this facility can regulate its effluent flow and all discharges would be monitored to comply with discharge requirements, no impacts are expected. Fire sprinkler water and truck hose-down water would be collected in tanks, monitored for radioactivity, and then transferred to a treatment facility as required. Uncontaminated water would be pumped to storm drains.

The potential location of the pit disassembly/conversion facility would be located outside the 100-year floodplain. Information on the location of the 500-year floodplain at SRS is currently available only for a limited number of specific project areas. However, the pit disassembly/conversion facility at SRS would not likely affect, or be affected by the 500-year floodplain of either the Fourmile Branch or Upper Three Runs Creek because the facility would be located at an elevation of about 91 m (300 ft) above MSL and is approximately 33 m (107 ft) and 64 m (210 ft) above these streams and at distances from these streams of 0.8 km (0.5 mi) to 1.5 km (0.94 mi), respectively. The maximum flow that has occurred on the Upper Three Runs Creek was in 1990, with a flow rate of about $58 \text{ m}^3/\text{s}$ ($2,040 \text{ ft}^3/\text{s}$). At that time the creek reached an elevation of almost 30 m (98 ft) above MSL (SR USGS 1996a:1). The elevations of the buildings in F-Area are more than 62 m (202 ft) above the highest flow elevation of the Upper Three Runs Creek. The maximum flow that has occurred on the Fourmile Branch was in 1991 with a rate of approximately $5 \text{ m}^3/\text{s}$ ($186 \text{ ft}^3/\text{s}$), and an elevation of about 61 m (199 ft) above MSL (SR USGS 1996a:1). Elevations of the buildings in F-Area are more than approximately 31 m (101 ft) higher than the maximum flow level that has occurred.

Groundwater. During construction, water requirements would be approximately 1.9 million l/yr (0.5 million gal/yr), which would represent less than a 0.01-percent increase over the projected annual

| groundwater withdrawal. This additional withdrawal should cause negligible impacts to groundwater availability. During operation, water used for cooling system makeup would be obtained from existing supply systems in the F-Area. The water for these systems is groundwater from the Cretaceous Aquifer. The total annual water requirements shown in Table 4.3.1.4–1 would represent a 0.7-percent increase in the projected No Action groundwater usage at SRS. The water withdrawals from groundwater would not impact regional groundwater levels. Previous studies using numerical simulations of groundwater withdrawals over 20 times greater than that required for the pit disassembly/conversion facility from the Cretaceous Aquifer indicate that drawdown could be almost 2 m (7 ft) at the well head, but would be smaller in overlying aquifers and would not extend beyond SRS boundaries in any aquifer (DOE 1991c:5-196). Therefore, it is expected that withdrawals attributed to the pit disassembly/conversion facility would have a minor drawdown at the well head and would not affect any aquifers in the area. No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected.

| [Text deleted.]

4.3.1.5 Geology and Soils

This section describes the environmental impacts to the geologic and soil resource as related to the construction and operation of the pit disassembly/conversion facility at any of the six sites analyzed: Hanford, NTS, INEL, Pantex, ORR, and SRS. A pit disassembly/conversion facility would involve some ground-disturbing construction activities (14 ha [35 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. The relative amount of annual precipitation (rainfall) is greater at ORR and SRS, than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on the geologic resource are anticipated. Neither facility construction and operational activities nor site infrastructure improvements would restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is low for Pantex, Hanford, INEL, and NTS. The soil erosion potential for ORR and SRS during construction and operational activities is moderate due primarily to the greater relative annual precipitation. Soil disturbance would occur primarily from ground-disturbing construction (foundation preparation) and activities associated with building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (as wind velocities and duration increase, soil erosion potential increases), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvement (buildings, roads, and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal. Indirect effects to the soil resource from infrastructure improvements would have a similar impact to the soil profile and erosion potential.

[Text deleted.]

4.3.1.6 Biological Resources

Construction of the pit disassembly/conversion facility would disturb 14 ha (35 acres) of land at each of the DOE sites analyzed. This includes areas on which plant facilities would be constructed, as well as areas used for construction laydown. Consultation with USFWS and State agencies would be conducted at the site-specific level, as appropriate, to avoid potential impacts to threatened and endangered species, and other protected species and habitat.

Hanford Site

It is assumed that the pit disassembly/conversion facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the pit disassembly/conversion facility would result in the disturbance of terrestrial habitat equaling about 0.01 percent of Hanford. This includes areas on which plant facilities would be constructed, as well as areas revegetated following construction. Vegetation within the assumed project site would be destroyed during land clearing operations. The facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the pit disassembly/conversion facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the pit disassembly/conversion facility. These disturbances may cause some species to move from the area. Disturbances to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the pit disassembly/conversion facility would not affect wetlands since no wetlands exist near the assumed facility location. Since water would be withdrawn from the Columbia River through an existing intake structure and wastewater would be discharged to evaporation/infiltration ponds, wetlands bordering the river would not be affected by placement of intake and discharge structures.

Aquatic Resources. Construction of a pit disassembly/conversion facility at Hanford would not impact aquatic resources, because there are no surface water bodies near the assumed facility location. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure so impacts to aquatic resources from impingement and entertainment would be minimal. Since the volume of water included represents a small percentage of the flow of the river, flow-related impacts to aquatic resources would be minimal. Wastewater would be discharged to evaporation/infiltration ponds, so aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the pit disassembly/conversion facility; however, sagebrush habitat would be disturbed. The sagebrush community is also important nesting/breeding and foraging habitat for several State-listed and candidate species, such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate before construction to determine the occurrence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the pit disassembly/conversion facility would be located in the Frenchman Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the pit disassembly/conversion facility at NTS would result in the disturbance of terrestrial resources equaling less than 0.01 percent of NTS. This includes areas on which facilities would be constructed, as well as areas used for construction laydown. Vegetative cover within the assumed project area, which is primarily creosote bush (Figure 3.3.6-1), would be destroyed during land-clearing operations. Creosote bush communities are well represented on NTS.

Construction of the pit disassembly/conversion facility would affect some animal populations. Less mobile animals, such as reptiles and small mammals, within the project area would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. Before construction, the site would be surveyed as necessary for the nests of migratory birds. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the pit disassembly/conversion facility would not affect wetlands, because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the pit disassembly/conversion facility would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location.

Threatened and Endangered Species. The threatened desert tortoise is a federally listed species that could be affected by construction of the pit disassembly/conversion facility at NTS. Construction activities, such as land-clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicular traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training, putting restrictions on vehicle speeds and off-road movement, conducting clearance surveys prior to surface disturbance, approving stop work authority if tortoises are found within work areas, removing tortoises from roadways and work areas, placing permanent and temporary tortoise-proof fencing around trenches, landfills, and treatment ponds, inspecting trenches, and having biologists survey when heavy

equipment is in use. The USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the pit disassembly/conversion facility.

[Text deleted.] Any listed plant species (Table 3.3.6-1) located within the construction area would be lost during land-clearing activities. Preactivity surveys would be conducted as appropriate before construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicular traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the pit disassembly/conversion facility (Section 4.3.1.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that the pit disassembly/conversion facility would be constructed within an undeveloped portion of the ICPP area. The ICPP area falls within the big sagebrush/thickspike wheatgrass/needle-and-thread grass community. Impacts to wildlife would be limited to small mammals and some birds and reptiles which could be displaced or suffer mortality. Large mammals are excluded from the assumed facility location by the perimeter fence and thus would not be impacted. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the area would have already adapted to similar disturbances. Due to the lack of wetlands or aquatic resources at the assumed facility location, these resources would not be affected by construction or operation of the pit disassembly/conversion facility. Since the facility would be located within the ICPP security area, impacts to threatened and endangered species would not be expected.

Pantex Plant

It is assumed that the pit disassembly/conversion facility would be located in Zone 12 which is a developed area that lacks natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the assumed site; however, small mammals and some birds and reptiles could be displaced by construction. Since the area does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the pit disassembly/conversion facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional wastewater could lead to a minor increase in open water near the outfall, as well as a slight change in plant species composition. No federally listed threatened or endangered species would be affected by construction or operation of the pit disassembly/conversion facility. Although the assumed site has been disturbed, it is possible that the State-listed Texas horned lizard could be present. Before construction, preactivity surveys would be conducted as appropriate.

Oak Ridge Reservation

It is assumed that the pit disassembly/conversion facility would be constructed on a disturbed area within Y-12. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal, since animals living adjacent to Y-12 would have already adapted to similar disturbances. There would be minimal direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal, since water would be taken from existing sources and discharged via NPDES-permitted outfalls and would involve minor volumes. Construction and operation of the pit disassembly/conversion facility would not be expected to impact threatened and endangered species due to the developed nature of the assumed facility location. Impacts to the Tennessee dace (State deemed in need of

management) would not be expected since erosion would be controlled and discharges would be through permitted outfalls.

Savannah River Site

It is assumed that the pit disassembly/conversion facility would be constructed within the F-Area, which is one of the highly developed industrial areas of the SRS. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area would have already adapted to similar disturbances. There would be minimal direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since minor volumes of water would be taken from existing sources and discharged via NPDES permitted outflows. Impacts from construction and operation of the pit disassembly/conversion facility would not be expected to impact threatened and endangered species due to the developed nature of the assumed facility location. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the site so that this species would not be directly affected by this action.

4.3.1.7 Cultural and Paleontological Resources

This section discusses potential impacts to cultural and paleontological resources that may result from the construction and operation of the pit disassembly/conversion facility at each of the representative sites analyzed. The total land disturbance for this facility is 14 ha (35 acres) during construction of which 12 ha (30 acres) would be used during operation. A 1.6-km (1-mi) reduced-access buffer zone would be created around the facility. The buffer zone would be contained within existing boundaries at all sites except ORR. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, building modification, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources have been identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. Any such sites may be identified through additional surveys. Any identified sites would be avoided. Operation would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified close to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The pit disassembly/conversion facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed lands necessary for the proposed facility may contain similar prehistoric or historic resources. Impacts to any identified resources would occur during construction, but not operation, of the proposed facility.

The CGTO has conducted surveys over portions of Frenchman Flat and has identified at least 20 plant species of importance to Native Americans. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from the construction and operation of the facility. Potential impacts include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological resources may be affected by construction, but not operation, of the facility.

Idaho National Engineering Laboratory

The pit disassembly/conversion facility would be constructed within the existing ICPP security area. The facility would be sited in a location previously approved for the construction of the Special Isotope Separation Project. A surface survey of the proposed project area identified no sites. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archaeological remains be discovered during construction. Two historic sites occur adjacent to the ICPP: one historic can scatter across the Big Lost River, to the northeast, and one abandoned homestead to the east. The can scatter is not considered eligible for NRHP listing and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed action. Facility construction and operation may have visual or auditory impact on traditional use areas or sacred sites. Resources may be identified through consultation with the interested tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain, which have produced fossilized remains. Operation would not have an effect on paleontological resources.

Pantex Plant

The pit disassembly/conversion facility would be constructed within Zone 12. Areas to be disturbed by development have not been systematically surveyed for cultural or paleontological resources. Prior to construction, additional survey work may be necessary. Because Zone 12 is disturbed and removed from water sources, it is unlikely to contain intact subsurface prehistoric or historic remains. Operation would have no additional impact to archaeological resources as it does not involve additional ground disturbance.

DOE has recently initiated consultation with Native American groups that have expressed interest in Pantex lands. To date, no Native American resources have been identified within Zone 12. Resources may be identified through additional consultation. Although no mortuary remains have been discovered at Pantex to date, it is possible that some exist within land to be disturbed by development. Burials are often considered to be important Native American resources. Also, construction and operation could affect traditionally used plant and animal species.

The surficial geology of the Pantex area consists of silts, clays, and sands of the Blackwater Draw Formation. In other areas of the High Plains, this formation has produced Late Pleistocene vertebrate remains including woolly mammoth, bison, and camel, sometimes in context with archaeological remains. The land to be disturbed during construction may contain some fossilized remains. Operation would not have an effect on paleontological resources.

Oak Ridge Reservation

No impacts to cultural or paleontological resources are expected to result from the construction or operation of the facility at ORR. It would be sited within Y-12. The area is disturbed and therefore unlikely to contain any intact archaeological deposits. No Native American resources have been identified at Y-12 to date, nor is it known to contain scientifically valuable paleontological remains.

Savannah River Site

The location for the pit disassembly/conversion facility is open space within F-Area. Portions of F-Area have been surveyed and contain sites potentially eligible for the NRHP. Additional surveys would be conducted in unsurveyed areas to be disturbed by construction. Site types known to occur at SRS include remains of

prehistoric base camps, quarries, and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by new facility construction, but not operation.

Some Native American resources may be affected by the proposed action. Resources such as prehistoric sites, cemeteries, and traditionally used plants could be affected during construction. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to the areas may also result from facility construction or operation. Resources would be identified through consultation with the potentially affected tribes.

No scientifically valuable fossil remains have been recorded at SRS to date. Facility construction and operation are not expected to affect paleontological resources.

[Text deleted.]

4.3.1.8 Socioeconomics

This section analyzes the socioeconomic effects of the pit disassembly/conversion facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. The effects at all sites are found in the Supplemental Socioeconomic Data Report (Socio 1996).

Regional Economy Characteristics. Constructing the pit disassembly/conversion facility at any of the sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 185 workers in the peak year of construction at any site. The largest increase in regional employment (much less than 1 percent) among the sites analyzed would be at INEL. A total of 376 new jobs (185 direct and 191 indirect) would be generated and regional unemployment would fall from 5.4 to 5.1 percent. The largest increase in regional per capita income would also occur at INEL, but the increase would be much less than 1 percent over No Action (Socio 1996a).

Operating the facility would generate greater socioeconomic changes than would construction, due to the larger, more permanent workforce. A workforce of 830 would be required for full operation at any site. Implementing the alternative at INEL would generate the largest increases in regional employment (about 2 percent) and per capita income (about 1 percent). A total of 3,056 new jobs (830 direct and 2,226 indirect) would be generated by the operational activities and regional unemployment would fall to 3.8 percent (Socio 1996a).

Population and Housing. At all of the sites analyzed, construction employment requirements would be met by the available resident labor force, but some in-migrating workers would be needed to fill more specialized positions during operations. Project-related population increases would be greatest if the facility is located at Pantex. However, this increase would be less than 1 percent over No Action population projections. Housing units, in excess of existing vacancies, may be required at all of the sites analyzed, except NTS and ORR, to accommodate the population increase. The greatest increase would be needed in the INEL ROI but this would be less than 1 percent over No Action estimates. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the population growth at all of the sites analyzed (Socio 1996a).

Community Services. During construction, there would be minimal impacts to community services in the ROIs of any of the sites analyzed. However, operation of the facility would slightly increase the demand for community services. The effects of population increase due to in-migrating workers during operations would be minor at all sites analyzed. The following discussion focuses on the Pantex and INEL ROIs, which are expected to experience the greatest increases in demand for community services among the sites analyzed.

To maintain the No Action student-to-teacher ratio of 16.3:1 in the Pantex ROI, 18 new teachers would be needed during operation of the proposed facility. The increase in teacher requirements, however, would be distributed over several school districts in the ROI; therefore, no single district would be significantly affected (Socio 1996a).

To maintain the No Action service level of 1.6 sworn police officers per 1,000 persons, only 2 new police officers would be needed in the INEL ROI. Five additional firefighters would be required to sustain the No Action service level of 2.3 firefighters per 1,000 persons in the Pantex ROI (Socio 1996a).

Projected hospital occupancy rates would increase slightly over No Action levels at each site analyzed. However, projected capacities would be capable of accommodating these small increases in patient load. To maintain the No Action service level of 1.2 physicians per 1,000 persons, only 2 additional physicians would be required in the INEL ROI during operation (Socio 1996a).

Local Transportation. Construction of the pit disassembly/conversion facility would not affect the level of service on the local road segments analyzed for any of the sites. However, traffic generated from facility

operations at INEL would affect the level of service on one road segment. U.S. 20/26 from U.S. 26 East to Idaho State Route 22/33 would experience a drop in level of service from B to C (Socio 1996a).

4.3.1.9 Public and Occupational Health and Safety

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the pit disassembly/conversion facility, whose activities are common to the Pu disposition alternatives. The section first describes the impacts from normal facility operation at each potential site, followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation are presented in Tables 4.3.1.9-1 and 4.3.1.9-2, respectively. Impacts from hazardous chemicals to these same groups are given in Table 4.3.1.9-3. Summaries of impacts associated with postulated accidents are given in Tables 4.3.1.9-4 through 4.3.1.9-9. Detailed results are presented in Appendix M.

Normal Operation. There would be no radiological releases associated with the construction of the pit disassembly/conversion facility at any of the sites analyzed. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the pit disassembly/conversion facility at each of the sites are presented in Table 4.3.1.9-1. The impacts from all site operations, including the new pit disassembly/conversion facility, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the maximally exposed member of the public from annual pit facility operation would range from 1.5×10^{-4} mrem at NTS to 0.014 mrem at ORR. From 10 years of operation, the corresponding risks of fatal cancer to this individual would range from 7.6×10^{-10} to 7.0×10^{-8} . The impacts to the average individual would be less. As a result of annual facility operation, the population dose would range from 2.9×10^{-4} person-rem at NTS to 0.12 person-rem at ORR. The corresponding numbers of fatal cancer in these populations from 10 years of operation would range from 1.5×10^{-6} to 6.0×10^{-4} .

The dose to the maximally exposed member of the public from annual total site operations are all within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would range from 1.1×10^{-3} mrem at Pantex to 3.2 mrem at ORR. From 10 years of operation, the corresponding risk of fatal cancers to this individual would range from 5.5×10^{-9} to 1.6×10^{-5} . The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operation, the population doses would be within the limit in proposed in 10 CFR 834, and would range from 4.0×10^{-3} person-rem at NTS to 44 person-rem at SRS. The corresponding number of fatal cancers in these populations from 10 years of operation would range from 2.0×10^{-5} to 0.22.

Doses to onsite workers from normal operations are given in Table 4.3.1.9-2. Included are involved workers directly associated with the pit disassembly/conversion facility, workers who are not involved with the pit disassembly/conversion facility, and the entire workforce at each site. All doses fall within regulatory limits.

The annual dose to pit disassembly/conversion facility workers is site-independent and would be 200 mrem to the average facility worker and 83 person-rem to the entire facility workforce. The annual dose to the average noninvolved worker would range from 2.6 mrem at ORR to 32 mrem at SRS. The annual total dose to all noninvolved workers would range from 3.0 person-rem at NTS to 250 person-rem at Hanford. The annual dose

Table 4.3.1.9-1. Potential Radiological Impacts to the Public During Normal Operation of the Pit Disassembly/Conversion Facility

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site ^a	Facility	Total Site ^a	Facility	Total Site ^a	Facility	Total Site ^a	Facility	Total Site ^a	Facility	Total Site ^a
Annual Dose to the Maximally Exposed Individual Member of the Public^b												
Atmospheric release pathway (mrem)	2.9x10 ⁻⁴	4.5x10 ⁻³	1.5x10 ⁻⁴	4.2x10 ⁻³	1.8x10 ⁻⁴	0.018	1.1x10 ⁻³	1.1x10 ⁻³	0.014	1.5	1.6x10 ⁻³	0.42
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0	0	0.10	0	0.081
Total liquid release pathway (mrem)	0	9.5x10 ⁻⁴	0	0	0	0	0	0	0	1.7	0	0.37
Atmospheric and liquid release pathways combined (mrem)	2.9x10 ⁻⁴	5.4x10 ⁻³	1.5x10 ⁻⁴	4.2x10 ⁻³	1.8x10 ⁻⁴	0.018	1.1x10 ⁻³	1.1x10 ⁻³	0.014	3.2	1.6x10 ⁻³	0.79
Percent of natural background ^c	9.6x10 ⁻⁵	1.8x10 ⁻³	4.8x10 ⁻⁵	1.4x10 ⁻³	5.4x10 ⁻⁵	5.3x10 ⁻³	3.4x10 ⁻⁴	3.4x10 ⁻⁴	4.8x10 ⁻³	1.1	5.4x10 ⁻⁴	0.27
10-year fatal cancer risk	1.4x10 ⁻⁹	2.7x10 ⁻⁸	7.6x10 ⁻¹⁰	2.1x10 ⁻⁸	9.0x10 ⁻¹⁰	9.0x10 ⁻⁸	5.5x10 ⁻⁹	5.5x10 ⁻⁹	7.0x10 ⁻⁸	1.6x10 ⁻⁵	8.0x10 ⁻⁹	4.0x10 ⁻⁶
[Text deleted.]												
Annual Population Dose Within 80 Kilometers^d												
Atmospheric release pathway (person-rem)	0.016	0.48	2.9x10 ⁻⁴	4.0x10 ⁻³	3.2x10 ⁻³	2.4	6.4x10 ⁻³	6.7x10 ⁻³	0.12	29	0.11	41
Total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	4.7	0	3.6
Atmospheric and liquid release pathways combined (person-rem)	0.016	1.6	2.9x10 ⁻⁴	4.0x10 ⁻³	3.2x10 ⁻³	2.4	6.4x10 ⁻³	6.7x10 ⁻³	0.12	34	0.11	44
Percent of natural background ^c	8.6x10 ⁻⁶	8.4x10 ⁻⁴	3.2x10 ⁻⁶	4.4x10 ⁻⁵	3.5x10 ⁻⁶	2.7x10 ⁻³	5.5x10 ⁻⁶	5.8x10 ⁻⁶	3.1x10 ⁻⁵	9.0x10 ⁻³	4.1x10 ⁻⁵	0.017
10-year fatal cancers	8.0x10 ⁻⁵	7.9x10 ⁻³	1.5x10 ⁻⁶	2.0x10 ⁻⁵	1.5x10 ⁻⁵	0.012	3.3x10 ⁻⁵	3.4x10 ⁻⁵	6.0x10 ⁻⁴	0.17	5.6x10 ⁻⁴	0.22
[Text deleted.]												

Table 4.3.1.9-1. Potential Radiological Impacts to the Public During Normal Operation of the Pit Disassembly/Conversion Facility—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a
Annual Dose to the Average Individual Within 80 Kilometers ^c												
Atmospheric and liquid release pathways combined (mrem)	2.6x10 ⁻⁵	2.6x10 ⁻³	9.9x10 ⁻⁶	1.3x10 ⁻⁴	1.1x10 ⁻⁵	8.9x10 ⁻³	1.8x10 ⁻⁵	1.9x10 ⁻⁵	9.4x10 ⁻⁵	0.026	1.2x10 ⁻⁴	0.049
10-year fatal cancer risk	1.3x10 ⁻¹⁰	1.3x10 ⁻⁸	4.9x10 ⁻¹¹	6.6x10 ⁻¹⁰	5.5x10 ⁻¹¹	4.5x10 ⁻⁸	9.2x10 ⁻¹¹	9.6x10 ⁻¹¹	4.7x10 ⁻¹⁰	1.3x10 ⁻⁷	6.1x10 ⁻¹⁰	2.5x10 ⁻⁷
[Text deleted.]												

^a Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9). The location of the MEI may be different under No Action than for operation of the new pit disassembly/conversion facility. Therefore, the impacts may not be directly additive.

^b The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways as required by NESHAPS (40 CFR 61, Subpart H) under the CAA, 4 mrem per year from the drinking water pathway as required by the SDWA, and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

^c The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem; the population within 80 km receives 186,400 person-rem. (2) NTS: the average individual receives 313 mrem; the population within 80 km receives 9,190 person-rem. (3) INEL: the average individual receives 338 mrem; the population within 80 km receives 90,800 person-rem. (4) Pantex: the average individual receives 334 mrem; the population within 80 km receives 116,900 person-rem. (5) ORR: the average individual receives 295 mrem; the population within 80 km (50mi) receives 379,000 person-rem. (6) SRS: the average individual receives 298 mrem; the population within 80 km receives 266,000 person-rem.

^d For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

^e Obtained by dividing the population dose by the number of people projected to be living within 80 km of the site (621,000 at Hanford; 29,400 at NTS; 269,000 at INEL; 350,000 at Pantex; 1,285,000 at ORR; and 893,000 at SRS).

Source: Section M.2.

Table 4.3.1.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Pit Disassembly/Conversion Facility

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce^a						
Average worker dose (mrem/yr) ^b	200	200	200	200	200	200
10-year risk of fatal cancer	8.0x10 ⁻⁴	8.0x10 ⁻⁴	8.0x10 ⁻⁴	8.0x10 ⁻⁴	8.0x10 ⁻⁴	8.0x10 ⁻⁴
[Text deleted.]						
Total dose (person-rem/yr)	83	83	83	83	83	83
10-year fatal cancers	0.34	0.34	0.34	0.34	0.34	0.34
[Text deleted.]						
Noninvolved Workforce^c						
Average worker dose (mrem/yr) ^b	27	5.0	30	10	2.6	32
10-year risk of fatal cancer	1.1x10 ⁻⁴	2.0x10 ⁻⁵	1.2x10 ⁻⁴	4.0x10 ⁻⁵	1.0x10 ⁻⁵	1.3x10 ⁻⁴
[Text deleted.]						
Total dose (person-rem/yr)	250	3.0	220	14	44	226
10-year fatal cancers	1.0	0.012	0.88	0.056	0.18	1.9
[Text deleted.]						
Total Site Workforce^d						
Dose (person-rem/yr)	333	86	303	97	127	309
10-year fatal cancers	1.7	0.43	1.5	0.49	0.64	1.5
[Text deleted.]						

^a The involved worker is a worker associated with operations of the proposed action.

^b The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

^c The noninvolved worker is a worker onsite but not associated with operations of the proposed action. The noninvolved workforce is equivalent to the No Action workforce.

^d The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

to the total site workforces would range from 86 person-rem at NTS to 333 person-rem at Hanford. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.1.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts from normal operation of the pit disassembly/conversion facility at several sites are presented in Table 4.3.1.9–3. Included are the impacts due only to operation of the pit disassembly/conversion facility and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI of the public due to the pit disassembly/conversion facility operation ranges from 4.0×10^{-6} at NTS to 1.6×10^{-4} at ORR. The cancer risk from hazardous chemicals to the MEI from the pit disassembly/conversion facility operation is zero (because no carcinogens are released from the hazardous chemicals used) at all sites. The HI to the onsite worker from the facility operation ranges from 2.6×10^{-4} at NTS and Pantex to 5.3×10^{-4} at ORR, and the cancer risk from the facility operation to the onsite worker is zero (because no carcinogens are released from the hazardous chemicals used) at all sites.

Facility Accidents. A set of potential accidents for the pit disassembly/conversion facility has been postulated for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Tables 4.3.1.9–4 through 4.3.1.9–9 for the sites analyzed (Hanford, NTS, INEL, Pantex, ORR, and SRS). In the event that the site boundary is less than 1,000 m (3,280 ft) from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed at each site, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 2.2 at ORR for the oxyacetylene explosion in a process cell accident scenario with a probability of 1.0×10^{-7} per year. The corresponding 10-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 2.2×10^{-6} , 1.4×10^{-8} , and 1.1×10^{-8} , respectively. The maximum population 10-year facility lifetime risk would be 1.7×10^{-4} (that is, one fatality in about 60,000 years) at ORR for the fire on the loading dock accident scenario with a probability of 5.0×10^{-4} per year. The corresponding maximum offsite individual and worker 10 year facility lifetime risks would be 9.3×10^{-7} and 7.5×10^{-7} , respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.1.9–4 through 4.3.1.9–9.

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new disposition facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is a possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] Admission of aircraft crash accidents for this PEIS is contained in Appendix R.

An indication of the magnitude to the impacts of an aircraft crash into a disposition facility is given by the earthquake scenario. The earthquake and aircraft crash scenarios are similar in that they both result in major

Table 4.3.1.9-3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Pit Disassembly/Conversion Facility

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b
Maximally Exposed Individual (Public)												
Hazard index ^c	2.7x10 ⁻⁵	8.8x10 ⁻⁵	4.0x10 ⁻⁶	4.0x10 ⁻⁶	5.8x10 ⁻⁵	0.015	1.5x10 ⁻⁴	5.8x10 ⁻³	1.6x10 ⁻⁴	0.039	7.3x10 ⁻⁶	5.2x10 ⁻³
Cancer risk ^d	0	0	0	0	0	3.6x10 ⁻⁶	0	1.1x10 ⁻⁸	0	0	0	1.3x10 ⁻⁷
Worker Onsite												
Hazard index ^e	5.0x10 ⁻⁴	4.4x10 ⁻³	2.6x10 ⁻⁴	2.6x10 ⁻⁴	5.1x10 ⁻⁴	0.22	2.6x10 ⁻⁴	6.4x10 ⁻³	5.3x10 ⁻⁴	0.15	4.5x10 ⁻⁴	1.2
Cancer risk ^f	0	0	0	0	0	7.7x10 ⁻⁴	0	4.4x10 ⁻⁷	0	0	0	1.9x10 ⁻⁴

^a Facility=Contribution from the proposed new facility operation only.

^b Total=Includes the contributions from the No Action and the proposed new facility operation.

^c Hazard Index for MEL=Sum of individual Hazard Quotients (noncancer health effects) for MEL.

^d Cancer Risk for MEL: (Emissions Concentrations) x (0.286 [converts concentrations to doses]) x (Slope Factor [SF]).

^e Hazard Index for Workers=Sum of individual Hazard Quotients (noncancer health effects) for workers.

^f Cancer Risk for Workers: (Emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [Fraction of year exposed]) x (0.571 [Fraction of lifetime working]) x (Slope Factor).

Note: Where there are no known carcinogens among the hazardous chemicals emitted, there are no slope factors; therefore, the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4-28 through M.3.4-33.

Table 4.3.1.9-4. Pit Disassembly/Conversion Facility Accident Impacts at Hanford Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c	Accident Frequency (per yr)
Fire on the loading dock	6.4x10 ⁻⁷	1.3x10 ⁻⁴	2.5x10 ⁻⁸	5.1x10 ⁻⁶	4.6x10 ⁻⁵	9.3x10 ⁻³	5.0x10 ⁻⁴
Fire in a process cell	7.6x10 ⁻¹³	7.6x10 ⁻¹⁰	3.0x10 ⁻¹⁴	3.0x10 ⁻¹¹	5.5x10 ⁻¹¹	5.5x10 ⁻⁸	1.0x10 ⁻⁴
Deflagration inside a glovebox	1.6x10 ⁻¹⁰	1.6x10 ⁻⁷	6.4x10 ⁻¹²	6.4x10 ⁻⁹	1.2x10 ⁻⁸	1.2x10 ⁻⁵	1.0x10 ⁻⁴
Impact induced spill	1.2x10 ⁻¹⁶	2.7x10 ⁻¹³	4.9x10 ⁻¹⁸	1.1x10 ⁻¹⁴	8.8x10 ⁻¹⁵	2.0x10 ⁻¹¹	4.5x10 ⁻⁵
Nuclear criticality	6.9x10 ⁻¹³	6.9x10 ⁻⁷	2.9x10 ⁻¹⁴	2.9x10 ⁻⁸	7.8x10 ⁻¹²	7.8x10 ⁻⁶	1.0x10 ⁻⁷
Beyond evaluation basis fire in a process cell	5.4x10 ⁻¹²	5.4x10 ⁻⁶	2.2x10 ⁻¹³	2.2x10 ⁻⁷	3.9x10 ⁻¹⁰	3.9x10 ⁻⁴	1.0x10 ⁻⁷
Oxyacetylene explosion in a process cell	9.4x10 ⁻⁹	9.4x10 ⁻³	3.2x10 ⁻¹⁰	3.2x10 ⁻⁴	5.8x10 ⁻⁷	0.58	1.0x10 ⁻⁷
Beyond evaluation basis earthquake	4.1x10 ⁻⁹	4.1x10 ⁻³	1.6x10 ⁻¹⁰	1.6x10 ⁻⁴	2.9x10 ⁻⁷	0.29	1.0x10 ⁻⁷
Expected risk ^d	6.5x10 ⁻⁷	-	2.6x10 ⁻⁸	-	4.7x10 ⁻⁵	-	-

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1-4 and M.5.3.1.1-5 and the MACCS computer code.

Table 4.3.1.9-5. Pit Disassembly/Conversion Facility Accident Impacts at Nevada Test Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c Accident Frequency (per yr)
Fire on the loading dock	4.4x10 ⁻⁷	8.7x10 ⁻⁵	1.0x10 ⁻⁸	2.0x10 ⁻⁶	1.0x10 ⁻⁶	2.1x10 ⁻⁴ 5.0x10 ⁻⁴
Fire in a process cell	5.2x10 ⁻¹³	5.2x10 ⁻¹⁰	1.2x10 ⁻¹⁴	1.2x10 ⁻¹¹	1.3x10 ⁻¹²	1.3x10 ⁻⁹ 1.0x10 ⁻⁴
Deflagration inside a glovebox	1.1x10 ⁻¹⁰	1.1x10 ⁻⁷	2.5x10 ⁻¹²	2.5x10 ⁻⁹	2.6x10 ⁻¹⁰	2.6x10 ⁻⁷ 1.0x10 ⁻⁴
Impact induced spill	8.3x10 ⁻¹⁷	1.9x10 ⁻¹³	1.9x10 ⁻¹⁸	4.3x10 ⁻¹⁵	2.0x10 ⁻¹⁶	4.5x10 ⁻¹³ 4.5x10 ⁻⁵
Nuclear criticality	5.0x10 ⁻¹³	5.0x10 ⁻⁷	1.1x10 ⁻¹⁴	1.1x10 ⁻⁸	1.6x10 ⁻¹³	1.6x10 ⁻⁷ 1.0x10 ⁻⁷
Beyond evaluation basis fire in a process cell	3.7x10 ⁻¹²		8.6x10 ⁻¹⁴	8.6x10 ⁻⁸	8.9x10 ⁻¹²	8.9x10 ⁻⁶ 1.0x10 ⁻⁷
Oxyacetylene explosion in a process cell	6.3x10 ⁻⁹	6.3x10 ⁻³	1.3x10 ⁻¹⁰	1.3x10 ⁻⁴	1.3x10 ⁻⁸	0.013 1.0x10 ⁻⁷
Beyond evaluation basis earthquake	2.7x10 ⁻⁹	2.7x10 ⁻³	6.3x10 ⁻¹¹	6.3x10 ⁻⁵	6.5x10 ⁻⁹	6.5x10 ⁻³ 1.0x10 ⁻⁷
Expected risk ^d	4.5x10 ⁻⁷	-	1.0x10 ⁻⁸	-	1.1x10 ⁻⁶	- -

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1-4 and M.5.3.1.1-5 and the MACCS computer code.

Table 4.3.1.9-6. Pit Disassembly/Conversion Facility Accident Impacts at Idaho National Engineering Laboratory

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c	Accident Frequency (per yr)
Fire on the loading dock	6.0x10 ⁻⁷	1.2x10 ⁻⁴	6.4x10 ⁻⁹	1.3x10 ⁻⁶	1.4x10 ⁻⁵	2.8x10 ⁻³	5.0x10 ⁻⁴
Fire in a process cell	7.1x10 ⁻¹³	7.1x10 ⁻¹⁰	7.7x10 ⁻¹⁵	7.7x10 ⁻¹²	1.7x10 ⁻¹¹	1.7x10 ⁻⁸	1.0x10 ⁻⁴
Deflagration inside a glovebox	1.5x10 ⁻¹⁰	1.5x10 ⁻⁷	1.6x10 ⁻¹²	1.6x10 ⁻⁹	3.5x10 ⁻⁹	3.5x10 ⁻⁶	1.0x10 ⁻⁴
Impact induced spill	1.1x10 ⁻¹⁶	2.5x10 ⁻¹³	1.2x10 ⁻¹⁸	2.7x10 ⁻¹⁵	2.7x10 ⁻¹⁵	5.9x10 ⁻¹²	4.5x10 ⁻⁵
Nuclear criticality	6.7x10 ⁻¹³	6.7x10 ⁻⁷	6.7x10 ⁻¹⁵	6.7x10 ⁻⁹	2.1x10 ⁻¹²	2.1x10 ⁻⁶	1.0x10 ⁻⁷
Beyond evaluation basis fire in a process cell	5.1x10 ⁻¹²	5.1x10 ⁻⁶	5.5x10 ⁻¹⁴	5.5x10 ⁻⁸	1.2x10 ⁻¹⁰	1.2x10 ⁻⁴	1.0x10 ⁻⁷
Oxyacetylene explosion in a process cell	9.2x10 ⁻⁹	9.2x10 ⁻³	8.0x10 ⁻¹¹	8.0x10 ⁻⁵	1.7x10 ⁻⁷	0.17	1.0x10 ⁻⁷
Beyond evaluation basis earthquake	3.7x10 ⁻⁹	3.7x10 ⁻³	4.0x10 ⁻¹¹	4.0x10 ⁻⁵	8.6x10 ⁻⁸	0.086	1.0x10 ⁻⁷
Expected risk ^d	6.1x10 ⁻⁷	-	6.6x10 ⁻⁹	-	1.4x10 ⁻⁵	-	-

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1-4 and M.5.3.1.1-5 and the MACCS computer code.

Table 4.3.1.9-7. Pit Disassembly/Conversion Facility Accident Impacts at Pantex Plant

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c
Fire on the loading dock	2.6x10 ⁻⁷	5.1x10 ⁻⁵	1.0x10 ⁻⁷	2.0x10 ⁻⁵	1.6x10 ⁻⁵	3.2x10 ⁻³
Fire in a process cell	3.1x10 ⁻¹³	3.1x10 ⁻¹⁰	1.2x10 ⁻¹³	1.2x10 ⁻¹⁰	1.9x10 ⁻¹¹	1.9x10 ⁻⁸
Deflagration inside a glovebox	6.4x10 ⁻¹¹	6.4x10 ⁻⁸	2.6x10 ⁻¹¹	2.6x10 ⁻⁸	3.9x10 ⁻⁹	3.9x10 ⁻⁶
Impact induced spill	4.9x10 ⁻¹⁷	1.1x10 ⁻¹³	2.0x10 ⁻¹⁷	4.3x10 ⁻¹⁴	3.0x10 ⁻¹⁵	6.7x10 ⁻¹²
Nuclear criticality	3.1x10 ⁻¹³	3.1x10 ⁻⁷	1.4x10 ⁻¹³	1.4x10 ⁻⁷	4.8x10 ⁻¹²	4.8x10 ⁻⁶
Beyond evaluation basis fire in a process cell	2.2x10 ⁻¹²	2.2x10 ⁻⁶	8.7x10 ⁻¹³	8.7x10 ⁻⁷	1.3x10 ⁻¹⁰	1.3x10 ⁻⁴
Oxyacetylene explosion in a process cell	3.3x10 ⁻⁹	3.3x10 ⁻³	1.3x10 ⁻⁹	1.3x10 ⁻³	2.0x10 ⁻⁷	0.20
Beyond evaluation basis earthquake	1.6x10 ⁻⁹	1.6x10 ⁻³	6.4x10 ⁻¹⁰	6.4x10 ⁻⁴	9.8x10 ⁻⁸	0.098
Expected risk ^d	2.6x10 ⁻⁷	-	1.0x10 ⁻⁷	-	1.6x10 ⁻⁵	-

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1-4 and M.5.3.1.1-5 and the MACCS computer code.

Table 4.3.1.9-8. Pit Disassembly/Conversion Facility Accident Impacts at Oak Ridge Reservation

Accident Description	Worker at 772 m			Maximum Offsite Individual			Population to 80 km		
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c	Accident Frequency (per yr)
Fire on the loading dock	7.5×10^{-7}	1.5×10^{-4}	9.3×10^{-7}	1.9×10^{-4}	1.7×10^{-4}	1.9×10^{-4}	0.035	5.0×10^{-4}	
Fire in a process cell	8.9×10^{-13}	8.9×10^{-10}	1.1×10^{-12}	1.1×10^{-9}	2.1×10^{-10}	1.1×10^{-9}	2.1×10^{-7}	1.0×10^{-4}	
Deflagration inside a glovebox	1.9×10^{-10}	1.9×10^{-7}	2.3×10^{-10}	2.3×10^{-7}	4.3×10^{-8}	2.3×10^{-7}	4.3×10^{-5}	1.0×10^{-4}	
Impact induced spill	1.4×10^{-16}	3.2×10^{-13}	1.8×10^{-17}	4.0×10^{-13}	3.3×10^{-14}	4.0×10^{-13}	7.4×10^{-11}	4.5×10^{-5}	
Nuclear criticality	7.8×10^{-13}	7.8×10^{-7}	9.8×10^{-13}	9.8×10^{-7}	6.6×10^{-11}	9.8×10^{-7}	6.6×10^{-5}	1.0×10^{-7}	
Beyond evaluation basis fire in a process cell	6.3×10^{-12}	6.3×10^{-6}	7.9×10^{-12}	7.9×10^{-6}	1.5×10^{-9}	7.9×10^{-6}	1.5×10^{-3}	1.0×10^{-7}	
Oxyacetylene explosion in a process cell	1.1×10^{-8}	0.011	1.4×10^{-8}	0.014	2.2×10^{-6}	0.014	2.2	1.0×10^{-7}	
Beyond evaluation basis earthquake	4.6×10^{-9}	4.6×10^{-3}	5.8×10^{-9}	5.8×10^{-3}	1.1×10^{-6}	5.8×10^{-3}	1.1	1.0×10^{-7}	
Expected risk ^d	7.6×10^{-7}	-	9.5×10^{-7}	-	1.8×10^{-4}	-	-	-	

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 772 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [772 m for the facility at ORR], whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1-4 and M.5.3.1.1-5 and the MACCS computer code.

Table 4.3.1.9-9. Pit Disassembly/Conversion Facility Accident Impacts at Savannah River Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c Accident Frequency (per yr)
Fire on the loading dock	4.2x10 ⁻⁷	8.4x10 ⁻⁵	1.0x10 ⁻⁸	2.0x10 ⁻⁶	5.0x10 ⁻⁵	9.9x10 ⁻³ 5.0x10 ⁻⁴
Fire in a process cell	5.0x10 ⁻¹³	5.0x10 ⁻¹⁰	1.2x10 ⁻¹⁴	1.2x10 ⁻¹¹	5.9x10 ⁻¹¹	5.9x10 ⁻⁸ 1.0x10 ⁻⁴
Deflagration inside a glovebox	1.0x10 ⁻¹⁰	1.0x10 ⁻⁷	2.6x10 ⁻¹²	2.6x10 ⁻⁹	1.2x10 ⁻⁸	1.2x10 ⁻⁵ 1.0x10 ⁻⁴
Impact induced spill	8.0x10 ⁻¹⁷	1.8x10 ⁻¹³	2.0x10 ⁻¹⁸	4.4x10 ⁻¹⁵	9.5x10 ⁻¹⁵	2.1x10 ⁻¹¹ 4.5x10 ⁻⁵
Nuclear criticality	4.5x10 ⁻¹³	4.5x10 ⁻⁷	1.0x10 ⁻¹⁴	1.0x10 ⁻⁸	1.0x10 ⁻¹¹	1.0x10 ⁻⁵ 1.0x10 ⁻⁷
Beyond evaluation basis fire in a process cell	3.6x10 ⁻¹²	3.6x10 ⁻⁶	8.7x10 ⁻¹⁴	8.7x10 ⁻⁸	4.2x10 ⁻¹⁰	4.2x10 ⁻⁴ 1.0x10 ⁻⁷
Oxyacetylene explosion in a process cell	5.8x10 ⁻⁹	5.8x10 ⁻³	1.3x10 ⁻¹⁰	1.3x10 ⁻⁴	6.2x10 ⁻⁷	0.62 1.0x10 ⁻⁷
Beyond evaluation basis earthquake	2.8x10 ⁻⁹	2.8x10 ⁻³	6.4x10 ⁻¹¹	6.4x10 ⁻⁵	3.1x10 ⁻⁷	0.31 1.0x10 ⁻⁷
Expected risk ^d	4.3x10 ⁻⁷	-	1.0x10 ⁻⁸	-	5.1x10 ⁻⁵	-

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source terms in Tables M.5.3.1.1-4 and M.5.3.1.1-5 and the MACCS computer code.

structural damage and the release of Pu directly to the environment. They differ in that an earthquake induced fire is based on limited combustible materials while the aircraft crash has the potential for a major fuel related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive serious or fatal injuries.

| [Text deleted.]

4.3.1.10 Waste Management

This section summarizes the waste management impacts for the construction and operation of a pit disassembly/conversion facility. There is no spent nuclear fuel or HLW associated with the operation of the pit disassembly/conversion facility. Table 4.3.1.10–1 provides the estimated operational waste volumes projected to be generated at the sites analyzed as a result of the pit disassembly/conversion facility. Facilities that would support the pit disassembly/conversion facility would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA, and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous and nonhazardous wastes would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the pit disassembly/conversion facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.2.1. A detailed description of the waste management activities that would be required to support the pit disassembly/conversion facility can also be found in Section E.3.2.1.

Construction and operation of a pit disassembly/conversion facility would impact existing waste management activities at each of the sites analyzed, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any are generated, it would be managed in accordance with site practice, and all applicable Federal and State regulations.

Approximately 67 m³ (88 yd³) of TRU waste consisting of retired gloveboxes, contaminated wipes and rags, plastics, packaging materials, declassified components, and glovebox sweepings would require treatment and repackaging to meet the current planning-basis WIPP WAC or alternative treatment level. Hanford, INEL, and SRS have existing and planned TRU waste facilities that could be utilized. ORNL has the only existing or planned capability at ORR to handle TRU waste. ORNL existing and planned TRU waste facilities could handle this increase. Due to their limited capability to process, package, and store TRU waste, a radwaste facility would need to be constructed as part of the pit disassembly/conversion facility if sited at Pantex or NTS. A small quantity (4 m³ [6 yd³]) of mixed TRU waste would require treatment and packaging to meet the current planning-basis WIPP WAC or alternative treatment level. Mixed TRU waste would be principally leaded rubber gloves. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), eight truck shipments per year or, if applicable, four regular train shipments per year or one dedicated train shipment per year, would be required.

All of the sites analyzed have existing or planned facilities that could manage the small quantities of LLW. Approximately 102 m³ (133 yd³) of LLW from paper and surgeon's gloves, which are discarded inside the Radioactive Materials Area but external to gloveboxes, and solidified liquid LLW would require disposal. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.03 ha/yr (0.08 acre/yr) at Hanford and ORR, 0.02 ha/yr (0.04 acre/yr) at NTS and INEL, and 0.01 ha/yr (0.03 acre/yr) at SRS. With no onsite LLW disposal capability, Pantex would require six additional LLW shipments per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

A small quantity (0.4 m³ [100 gal]) of liquid and (1.7 m³ [2.2 yd³]) of solid mixed LLW consisting of solvents, lead, and vacuum pump oil that have been contaminated with radioactive constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the Tri-Party

Table 4.3.1.10-1. Estimated Annual Generated Waste Volumes for the Pit Disassembly/Conversion Facility^a

Category	New Facility (m ³)	Hanford	NTS	INEL	Pantex	ORR	SRS
		No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)
Transuranic							
Liquid	0	None	None	None	None	None	None
Solid	67	271	None	3.5	None	119	338
Mixed Transuranic							
Liquid	0	None	None	None	None	None	None
Solid	4	98	None	Included in TRU	None	None	Included in TRU
Low-Level							
Liquid	4 ^b	None	Dependent on restoration activities	None	8	2,970	74,000
Solid	102	3,390	15,000	7,200	32	7,320	16,400
Mixed Low-Level							
Liquid	0.4	3,760	None	4	4	87,600	1,330
Solid	1.7	1,505	50	170	46	432	7,700
Hazardous							
Liquid	2	Included in solid	Included in solid	Included in solid	2	6,460	1,260
Solid	0.7	560	212	1,200	31	26	15,100
Nonhazardous (Sanitary)							
Liquid	85,200	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000
Solid	100	5,107	2,120	52,000	339	53,100	61,200
Nonhazardous (Other)							
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	None	Included in sanitary	650,000	Included in sanitary
Solid	3 ^c	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary

^a The No Action volumes are from Tables 4.2.1.10-1, 4.2.2.10-1, 4.2.3.10-1, 4.2.4.10-1, 4.2.5.10-1, and 4.2.6.10-1. Incremental waste generation volumes for pit disassembly/conversion are from Table E.3.2.1-1. Waste effluent volumes (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in Table E.3.2.1-1.

^b Liquid LLW would be treated and solidified prior to disposal.

^c Recyclable wastes.

Agreement for Hanford or the respective site treatment plan that was developed to comply with the *Federal Facility Compliance Act* for the remainder of the sites analyzed.

Liquid hazardous waste would consist of cleaning solvents, vacuum pump oils, film processing fluids, hydraulic fluids from mechanical equipment, antifreeze solutions, and paint. Liquid hazardous waste would be treated onsite or collected in DOT-approved containers and shipped offsite to RCRA-permitted treatment facilities. After treatment, the waste would be disposed of offsite in commercial RCRA-permitted disposal facilities. Solid hazardous waste would consist of lead packing and wipes contaminated with oils, lubricants, and cleaning solvents. After compaction, solid hazardous waste would be packaged in DOT-approved containers, treated onsite or offsite, and shipped to RCRA-permitted treatment and disposal facilities. All the sites analyzed would have adequate capacity to stage the 2 m^3 (500 gal) of liquid and 0.7 m^3 (0.9 yd^3) of solid hazardous waste until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

Approximately $85,200 \text{ m}^3$ (22,500,000 gal) of liquid nonhazardous sanitary and industrial wastewater, steam plant blowdown, and estimated stormwater runoff would require treatment, in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems may be required. The 100 m^3 (131 yd^3) of solid nonhazardous waste such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

4.3.2 PLUTONIUM CONVERSION FACILITY

The environmental impacts described in the following sections are based on the analysis of the Pu conversion facility as described in Section 2.4.2. The representative sites used for this facility are: Hanford, NTS, INEL, Pantex, ORR, and SRS. These sections describe the construction and operational impacts of the Pu conversion facility on the following potentially affected areas: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomic, public and occupational health and safety, and waste management.

In accordance with the Preferred Alternative for surplus Pu disposition, the Pu conversion facility could be located at either Hanford or SRS. Further tiered NEPA review will be conducted to examine alternative locations including new and existing facilities at these two sites should the Preferred Alternative be selected at the ROD. Although new facilities are analyzed in Section 4.3.2.1 through 4.3.2.10, DOE would preserve the option for using existing facilities to the extent practical pursuant to subsequent tiered NEPA review.

4.3.2.1 Land Resources

At all sites, the Pu conversion facility would disturb 36 ha (90 acres) of land during construction of which approximately 28 ha (70 acres) would be used during operations. The facility would be sited in a 1.6-km (1-mi) buffer zone contained within the boundary except at ORR, where the buffer zone is less than 1.6 km (1 mi). With the 1.6-km (1-mi) buffer zone, total land requirement would be 1,416 ha (3,500 acres). This section describes the impacts of constructing and operating the Pu conversion facility to land resources for each analysis site.

As discussed in Section 4.3.2.8, new housing construction at all sites should be sufficient to absorb the increase in population due to the in-migration of operational workers. No in-migration would occur during construction. No offsite land use would be affected; therefore, no indirect impacts would occur.

Hanford Site

Land Use. The potential site for the Pu conversion facility would utilize vacant land in the 200 Area adjacent to 200 East. Construction and operation of the Pu conversion facility would be in conformance with existing and future land use as described in the current *Hanford Site Development Plan* and with ongoing discussions in the comprehensive land use planning process. According to the *Hanford Site Development Plan*, 200 Areas land use is identified as waste operations, which includes radioactive material management, processing, and storage (HF DOE 1993c:13,14). [Text deleted.]

Construction and operation would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. Construction would be consistent with State and local (Benton, Franklin, and Grant Counties and the city of Richland) land-use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction and operation would be consistent with the industrialized landscape character of the 200 Areas. Construction and operation would be consistent with the current VRM Class 5 designation.

Nevada Test Site

Land Use. The potential location for the Pu conversion facility would be on undeveloped land in Area 6. Construction and operation of the facility in Area 6 would not be in conformance with the current *Nevada Test Site Development Plan*, which designates the southeast area of NTS as a nonnuclear test area. [Text deleted.] However, Area 6 is under a potential site for long-term storage and disposition of weapons-usable fissile materials as part of

the NTS defense program material disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8-3-9; NT DOE 1996e:A-18). [Text deleted.]

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, and controls of adjacent jurisdictions since none of these counties and municipalities currently undertake land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. Views of the proposed action would be blocked from sensitive viewpoints accessible to the public by mountainous terrain.

Idaho National Engineering Laboratory

Land Use. The proposed Pu conversion facility would be located on undeveloped land within the ICPP security area which is part of the central core area/Prime Development Land Zone of INEL (IN DOE 1992g:12). Construction and operation of the facility would be consistent with the current *Idaho National Engineering Laboratory Site Development Plan* which designates the future land use of the ICPP as receiving and storing spent nuclear fuels and radioactive wastes (IN DOE 1994d:9-8). [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction and operation would not be in conflict with land-use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operation of the facility would be consistent with the existing industrialized landscape character of the ICPP. Construction and operation would be consistent with the current VRM Class 5 designation of the area.

Pantex Plant

Land Use. Undeveloped land in Zone 12 is the potential location for the Pu conversion facility. The potential action would be consistent with the current *Pantex Site Development Plan* master plan, which designates Zone 12 as weapons assembly/disassembly (PX DOE 1995g:16). [Text deleted.]

Construction and operation would not affect other Pantex or offsite land uses. There would be no impacts to prime farmland. The alternative would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] The proposed visual environment would be consistent with the existing industrialized landscape character. Construction and operation would be consistent with the current VRM Class 5 designation of Zone 12.

Oak Ridge Reservation

Land Use. The Pu conversion facility is proposed to be sited on undeveloped land at Y-12. Weapons component manufacturing and development is among the future land uses designated for Y-12 by the future land use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan* (OR DOE 1989a:5-6-5-7). The alternative is compatible with the plan.

Construction and operation of the Pu conversion facility would not affect other ORR or offsite land uses. No prime farmlands exist onsite. Construction and operation would not be in conflict with the city of Oak Ridge

land-use plans, policies, and controls since the current *Oak Ridge Area Land Use Plan* designates the potential site for Industrial land use.

Visual Resources. Potential impacts to visual resources would not occur. The visual environment would be consistent with the existing industrial landscape character. Construction and operation would be consistent with the current VRM Class 5 designation of Y-12.

Savannah River Site

Land Use. Vacant land in the F-Area would be used for the Pu conversion facility. Construction and operation of the proposed facility would be in conformance with existing and future land use as designated by the current *Savannah River Site Development Plan*. According to the plan, current F-Area land use is designated industrial operations, while the future land-use category is primary industrial mission (SR DOE 1994d:11,12). Vacant land would be utilized.

Construction and operation would not affect other SRS or offsite land uses. There is no prime farmland on SRS. Construction and operation would not be in conflict with land-use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. [Text deleted.] The visual environment would be consistent with the industrial landscape character. Construction and operation would be consistent with current VRM Class 5 designation of the F-Area.

[Text deleted.]

4.3.2.2 Site Infrastructure

This section discusses the impacts on site infrastructure needed to support the Pu conversion facility at each of the six representative sites. Constructing and operating the facility would impact infrastructure at each site differently, depending on operating resources.

The Pu conversion facility would be composed of shipping and receiving, material management, processing operations, waste management, and necessary facility infrastructure and utility support functions. Construction would require approximately 6 years to complete. Table 4.3.2.2-1 presents a comparison of annual construction resource needs for each of the representative sites. Comparative impact of average annual resource needs for operation are presented in Table 4.3.2.2-2.

Table 4.3.2.2-1. Additional Site Infrastructure Needed for the Construction of the Plutonium Conversion Facility (Annual)

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	1,100	<1	157,850	0	0
Hanford					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage (without facility)	345,500	58	9,334,800	21,039,531	0
Projected usage (with facility)	346,600	59	9,492,650	21,039,531	0
Amount required in excess to site availability	0	0	0	0	0
NTS					
Site availability	176,844	45	5,716,000	0	0
Projected usage (without facility)	124,940	25	5,716,000	0	0
Projected usage (with facility)	126,040	26	5,873,850	0	0
Amount required in excess to site availability	0	0	157,850 ^a	0	0
INEL					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage (without facility)	232,500	42	5,820,000	0	11,340
Projected usage (with facility)	233,600	43	5,977,850	0	11,340
Amount required in excess to site availability	0	0	0	0	0

Table 4.3.2.2-1. Additional Site Infrastructure Needed for the Construction of the Plutonium Conversion Facility (Annual)—Continued

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	1,100	<1	157,850	0	0
Pantex					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage (without facility)	46,266	10	795,166	7,200,000	0
Projected usage (with facility)	47,366	11	953,016	7,200,000	0
Amount required in excess to site availability	0	0	0	0	0
ORR					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage (without facility)	726,000	110	379,000	95,000,000	16,300
Projected usage (with facility)	727,100	111	536,850	95,000,000	16,300
Amount required in excess to site availability	0	0	120,850 ^a	0	0
SRS					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage (without facility)	794,000	116	28,390,500	0	221,352
Projected usage (with facility)	795,100	117	28,548,350	0	221,350
Amount required in excess to site availability	0	0	148,350	0	0

^a Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LANL 1996c; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

Table 4.3.2.2-2. Additional Site Infrastructure Needed for the Operation of the
Plutonium Conversion Facility (Annual)

	Transportation			Electrical			Fuel		
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)		
Facility Requirement	<5	0	21,000	5	39,750	4,361,000	0		
Hanford									
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708		
Projected usage (without facility)	420	204	345,500	58	9,334,800	21,039,531	0		
Projected usage (with facility)	425	204	366,500	63	9,374,550	25,400,531	0		
Amount required in excess to site availability	<5	0	0	0	0	4,361,000 ^a	0		
NTS									
Site availability	1,100 ^b	0	176,844	45	5,716,000	0	0		
Projected usage (without facility)	645	0	124,940	25	5,716,000	0	0		
Projected usage (with facility)	650	0	145,940	30	5,755,750	4,361,000	0		
Amount required in excess to site availability	0	0	0	0	39,750 ^c	4,361,000 ^a	0		
INEL									
Site availability	445	48	394,000	124	16,000,000	0	11,340		
Projected usage (without facility)	445	48	232,500	42	5,820,000	0	11,340		
Projected usage (with facility)	450	48	253,500	47	5,859,750	4,361,000	11,340		
Amount required in excess to site availability	<5	0	0	0	0	4,361,000 ^a	0		
Pantex									
Site availability	76	27	201,480	23	1,775,720	289,000,000	0		
Projected usage (without facility)	76	27	46,266	10	795,166	7,200,000	0		

Table 4.3.2.2-2. Additional Site Infrastructure Needed for the Operation of the Plutonium Conversion Facility (Annual)—Continued

	Transportation		Electrical			Fuel		
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)	
Facility Requirement	<5	0	21,000	5	39,750	4,361,000	0	
Projected usage (with facility)	81	27	67,266	15	834,916	11,561,000	0	
Amount required in excess to site availability	<5	0	0	0	0	0	0	
ORR								
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300	
Projected usage (without facility)	71	27	726,000	110	379,000	95,000,000	16,300	
Projected usage (with facility)	76	27	747,000	115	418,750	99,361,000	16,300	
Amount required in excess to site availability	<5	0	0	0	2,750 ^c	0	0	
SRS								
Site availability	230	103	1,672,000	330	28,390,500	0	244,000	
Projected usage (without facility)	230	103	659,000	130	28,390,500	0	210,000	
Projected usage (with facility)	235	103	680,000	135	28,430,250	4,361,000	210,000	
Amount required in excess to site availability	<5	0	0	0	39,750 ^c	4,361,000 ^a	0	

^a Facility would be adapted to use fuel oil instead of natural gas.

^b Includes both paved and unpaved roads.

^c Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LANL 1996c; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

Hanford Site

Resources needed for construction are well within site availability. These resources would represent a small fraction of those needed to operate the site. Operations impacts would be small. The planned Pu conversion facility would use natural gas as the primary utility fuel, and the total requirement for natural gas would be higher than the site currently has available. The additional amount could be procured normal contractual means. [Text deleted.]

Nevada Test Site

Resources needed for construction would be well within site availability for all resources except oil. These resources would represent a small fraction of those needed to operate the site. Operational impacts would be small except for utility fuel. The planned Pu conversion facility would use natural gas as the primary utility fuel. Since NTS uses fuel oil as its primary utility fuel, using natural gas in lieu of fuel oil would require additional infrastructure. The final facility design would be converted to a fuel oil basis. Fuel oil requirements would exceed current site availability, but can be procured through normal contractual means.

Idaho National Engineering Laboratory

Resources needed for construction would be within site availability. These resources would represent a small fraction of those needed to operate the site. Operations impacts would be small except for utility fuel. The planned Pu conversion facility would use natural gas as the primary utility fuel. Since INEL uses fuel oil as its primary utility fuel, using natural gas in lieu of fuel oil would require additional infrastructure. The final facility design would be converted to a fuel oil basis. With this conversion from natural gas to fuel oil, site infrastructure requirements are within site capacities. [Text deleted.]

Pantex Plant

Resources needed for construction would be within site availability. [Text deleted.] Operations requirements would be within site availability. Adequate electrical energy would be available from the regional power grid.

Oak Ridge Reservation

Except for fuel oil, resources needed for construction would be well within site availability. Additional fuel oil for construction could be procured through normal contractual means. These resources would represent a small fraction of those needed to operate the site. Operational impacts would be small. [Text deleted.] However, the total requirement for oil would be slightly higher than the site currently has available. The additional amount could be procured through normal contractual means.

Savannah River Site

Resources needed for construction would be within site availability for all resources except oil. Additional fuel oil for construction could be procured through normal contractual means. These resources would represent a small fraction of those needed to operate the site. Operational impacts would be within availability capacity except for oil and natural gas. Since SRS uses fuel oil as its primary utility fuel, using natural gas in lieu of fuel oil would require additional infrastructure. The final facility design would be converted to a fuel oil basis. With this conversion from natural gas to fuel oil, site infrastructure requirements would be within site capacities, except for oil. Additional oil could be procured through normal contractual means.

4.3.2.3 Air Quality and Noise

Construction and operation of the Pu conversion facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.2.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM₁₀ and TSP concentrations are expected to increase during the peak construction period, especially during dry and windy conditions. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction.

Emission rates for operation of the Pu conversion facility are presented in Table F.1.3–5. Air pollutant emissions sources associated with operations include the following:

- Increased operation of existing boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators

[Text deleted.]

- Toxic/hazardous pollutant emissions from facility processes

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for facility operation plus the No Action concentrations are presented in Table 4.3.2.3–1.

NOISE

The location of the facilities associated with the Pu conversion facility relative to the site boundary and sensitive receptors was examined for each of the six sites to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Table 4.3.2.3-1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Plutonium Conversion Facility and No Action Alternative

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ^a (µg/m ³)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)
Criteria Pollutants														
Carbon monoxide	8-hour	10,000	0.08	0.71	2,290	2,290.5	284	285.59	602	608.13	5	5.16	22	27.42
	1-hour	40,000	0.3	5.23	2,748	2,751.56	614	618.03	2,900	2,932.0	11	11.33	171	196.51
Lead	Calendar Quarter	1.5	<0.01	<0.01	b	b	0.001	0.001	0.09	0.09	0.05	0.05	<0.01	<0.01
	24-hour	0.5	<0.01	<0.01	c	c	c	c	c	c	c	c	c	c
Nitrogen dioxide	Annual	100	0.03	0.06	b	<0.01 ^d	4	4.03	2.15	2.29	3	3.01	5.7	5.81
Ozone	1-hour	235	c	e	e	e	e	e	e	e	e	e	e	e
Particulate matter less than or equal to 10 microns in diameter	Annual	50	<0.01	<0.01	9.4	9.4	5	5	8.73	8.73	1	1	3	3
Sulfur dioxide														
	24-hour	150	0.02	0.02	106	106	80	80	88.5	88.51	2	2	50.6	50.61
	Annual	52	<0.01	<0.01	8.4	8.4	6	6	<0.01	<0.01	2	2	14.5	14.5
	24-hour	260	<0.01	<0.01	94.6	94.6	135	135	<0.01	0.01	32	32	196	196
	3-hour	1,300	0.01	0.01	725	725	579	579	<0.01	0.04	80	80	823	823.03
	1-hour	1,018	0.02	0.02	c	c	c	c	c	c	c	c	c	c
	1-hour	655 ^f	0.02	0.02	c	c	c	c	c	c	c	c	c	c
	30-minute	1,045	c	c	c	c	c	c	<0.01	0.09	c	c	c	c
Mandated by State														
Gaseous fluoride (as HF)	30-day	0.8	b	<0.01 ^d	c	c	c	c	<0.75	<0.75	0.2	0.2	0.09	0.09
	7-day	1.6	b	<0.01 ^d	c	c	c	c	<0.75	<0.75	0.3	0.3	0.39	0.39
	24-hour	2.9	b	<0.01 ^d	c	c	c	c	0.75	0.75	0.6 ^g	0.6 ^g	1.04	1.04
	12-hour	3.7	b	<0.01 ^d	c	c	c	c	1.05	1.05	0.6 ^g	0.6 ^g	1.99	1.99
	8-hour	250	c	c	c	c	c	c	c	c	0.6	0.6	c	c
	3-hour	4.9	c	c	c	c	c	c	4.21	4.21	c	c	c	c
Hydrogen sulfide	1-hour	112	c	c	b	b	c	c	c	c	c	c	c	c
	30-minute	111	c	c	c	c	c	c	b	b	c	c	c	c

Table 4.3.2.3-1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Plutonium Conversion Facility and No Action Alternative—Continued

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ^a (μg/m ³)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action (μg/m ³)	Total (μg/m ³)	No Action (μg/m ³)	Total (μg/m ³)	No Action (μg/m ³)	Total (μg/m ³)	No Action (μg/m ³)	Total (μg/m ³)	No Action (μg/m ³)	Total (μg/m ³)	No Action (μg/m ³)	Total (μg/m ³)
Total suspended particulates	Annual	60	<0.01	<0.01	c	c	5	5	c	c	c	c	12.6	12.6
	24-hour	150	0.02	0.02	c	c	80	80	c	c	2	2	c	c
	3-hour	200	c	c	c	c	c	c	b	d	c	c	c	c
	1-hour	400	c	c	c	c	c	c	b	d	c	c	c	c
Hazardous and Other Toxic Compounds														
Ammonia	Annual	17	c	c	c	c	6	6	b	<0.01 ^d	c	c	c	c
	24-hour	100	<0.01	<0.01	c	c	c	c	c	c	c	c	b	<0.01 ^d
	8-hour	404.8	c	c	b	<0.01 ^d	c	c	c	c	b	<0.01 ^d	c	c
	30-minute	170	c	c	c	c	c	c	b	0.08 ^d	c	c	c	c
Chlorine	Annual	1.5	c	c	c	c	b	<0.01 ^d	b	<0.01 ^d	c	c	c	c
	24-hour	5	b	<0.01 ^d	c	c	c	c	c	c	c	c	7.63	7.63
	8-hour	35.7	c	c	b	<0.01 ^d	c	c	c	c	4.1	4.1	c	c
	30-minute	15	c	c	c	c	c	c	b	0.06 ^d	c	c	c	c
Ethanol	Annual	1,880	c	c	c	c	b	<0.01 ^d	b	<0.01 ^d	c	c	c	c
	24-hour	6,300	b	<0.01 ^d	c	c	c	c	c	c	c	c	b	<0.01 ^d
	8-hour	44,762	c	c	b	<0.01 ^d	c	c	c	c	b	<0.01 ^d	c	c
	30-minute	18,800	c	c	c	c	c	c	b	0.16 ^d	c	c	c	c
Hydrogen chloride	Annual	0.1	c	c	c	c	0.98	0.98	0.07	0.07	c	c	c	c
	24-hour	7	b	<0.01 ^d	c	c	c	c	c	c	c	c	b	0.01 ^d
	8-hour	750	c	c	b	<0.01 ^d	c	c	c	c	57	57	c	c
	30-minute	75	c	c	c	c	c	c	6.17	6.27	c	c	c	c
Hydrazine	Annual	0.0002	b	<0.00001 ^d	c	c	0.000001	0.000001	b	<0.0001 ^d	c	c	c	c
	24-hour	0.5	c	c	c	c	c	c	c	c	c	c	b	<0.01 ^d
	8-hour	1.3	c	c	b	<0.01 ^d	c	c	c	c	b	<0.01 ^d	c	c
	30-minute	0.13	c	c	c	c	c	c	b	0.01 ^d	c	c	c	c

Table 4.3.2.3-1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Plutonium Conversion Facility and No Action Alternative—Continued

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ^a (μg/m ³)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action (μg/m ³)	Total (μg/m ³)	No Action (μg/m ³)	Total (μg/m ³)	No Action (μg/m ³)	Total (μg/m ³)	No Action (μg/m ³)	Total (μg/m ³)	No Action (μg/m ³)	Total (μg/m ³)	No Action (μg/m ³)	Total (μg/m ³)
Nitric acid	Annual	5.2	c	c	c	c	0.64	0.64	b	<0.01 ^d	c	c	c	c
	24-hour	17	b	<0.01 ^d	c	c	c	c	c	c	c	c	50.96	50.96
	8-hour	123.8	c	c	b	<0.01 ^d	c	c	c	c	78	78	c	c
	30-minute	52	c	c	c	c	c	c	b	0.02 ^d	c	c	c	c
Phosphoric acid	Annual	1	c	c	c	c	b	<0.01 ^d	b	<0.01 ^d	c	c	c	c
	24-hour	3.3	b	<0.01 ^d	c	c	c	c	c	c	c	c	0.462	0.462
	8-hour	23.8	c	c	b	<0.01 ^d	c	c	c	c	b	<0.01 ^d	c	c
	30-minute	10	c	c	c	c	c	c	b	0.01 ^d	c	c	c	c
Sulfuric acid	Annual	10	c	c	c	c	b	<0.01 ^d	b	<0.01 ^d	c	c	c	c
	24-hour	3.3	b	<0.01 ^d	c	c	c	c	c	c	c	c	b	<0.01 ^d
	8-hour	23.8	c	c	b	<0.01 ^d	c	c	c	c	20	20	c	c
	30-minute	50	c	c	c	c	c	c	b	0.01 ^d	c	c	c	c

Table 4.3.2.3-1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Plutonium Conversion Facility and No Action Alternative—Continued

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ^a ($\mu\text{g}/\text{m}^3$)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action ($\mu\text{g}/\text{m}^3$)	Total ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)	Total ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)	Total ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)	Total ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)	Total ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)	Total ($\mu\text{g}/\text{m}^3$)
Hazardous and Other Toxic Compounds (continued)	Annual	0.077	b	<0.01 ^d	c	c	0.00097	0.004	0.21	0.24	c	c	c	c
	24-hour	6,750	c	c	c	c	c	c	c	c	c	c	b	0.21 ^d
	8-hour	6,405	c	c	b	0.06 ^d	c	c	c	c	b	0.02 ^d	c	c
	30-minute	1,350	c	c	c	c	c	c	51.1	54.69	c	c	c	c

^a The more stringent of the Federal and State standards is presented for each averaging time.

^b No sources of this pollutant have been identified.

^c No State standard for indicated averaging time.

^d The concentration represents the alternative contribution only.

^e Ozone, as a criteria pollutant, is not directly emitted nor monitored by the sites. See Section 4.1.3 for discussion of ozone-related issues.

^f At Hanford, the level is not to be exceeded more than twice in any seven consecutive days.

^g 8-hour averaging time concentration was used.

Note: Total concentrations are based on site contribution, including concentrations from ongoing activities (No Action), and do not include the contribution from non-facility sources.

Concentrations for other hazardous/toxic pollutants reported for No Action in Section 4.2 are unchanged for this alternative and are not shown here. Emission of unspecified cleaning solvents was not modeled.

Source: 40 CFR 50; ID DHW 1995a; ID DHW 1995b; LANL 1996c; NV DCNR 1995a; SC DHEC 1991a; SC DHEC 1992b; TN DEC 1994a; TN DHE 1991a; TX ACB 1987a; TX NRCC 1992a; TX NRCC 1995a; WA Ecology 1994a.

Nontraffic noise sources associated with operation of the Pu conversion facility include ventilation systems, cooling systems, and material handling equipment. These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the sites, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.2.4 Water Resources

The construction and operation of a Pu conversion facility would affect water resources. Water resource requirements and discharges provided in Tables C.1.1.2–2, C.2.1.2–2, and E.3.2.2–1 were used to assess impacts to surface and groundwater. The discussion of impacts are provided for each site separately. Table 4.3.2.4–1 presents No Action surface and groundwater uses and discharges at each site, and the potential changes resulting from construction and operation of the Pu conversion facility.

Hanford Site

Surface Water. Surface water from the Columbia River would be used as the water source for construction and operation of the Pu conversion facility. During construction, water requirements would be approximately 2.4 million l/yr (0.6 million gal/yr), which would represent a 0.02-percent increase over the existing annual surface water withdrawal. This additional withdrawal would be negligible. During operation, water requirements would be approximately 80.5 million l/yr (21.2 million gal/yr), which would represent a 0.6-percent increase over the existing surface water withdrawal. This additional withdrawal would also be negligible.

| [Text deleted.]

During construction of the Pu conversion facility, sanitary and other nonhazardous wastewater (2.4 million l/yr [0.6 million gal/yr]), would be generated and discharged to the existing wastewater treatment systems at the 200 Area. The effluents from this facility would be discharged to evaporation/infiltration ponds. During operation, approximately 15 million l/yr (4 million gal/yr) of sanitary and other wastewater would be discharged to this wastewater treatment system. This would represent a 6.1-percent increase in the wastewater discharged at Hanford. All discharges would be monitored to comply with discharge limits. No impacts to surface water are expected.

The Pu conversion facility would be located in the 200 Area which is above the 100-year, 500-year, and probable maximum flood boundaries; flooding from dam failures; and flooding from a landslide resulting in river blockage.

Groundwater. No groundwater would be used during construction or operation of the Pu conversion facility; therefore, there would be no impacts to groundwater availability. No wastewater would be discharged directly to groundwater; therefore, groundwater quality should not be affected. Treated wastewater discharged to evaporation/infiltration ponds that does not evaporate, however, could percolate downward into the groundwater. This water would be monitored before discharge to the ponds and would not be discharged until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Nevada Test Site

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with any of the proposed facilities; groundwater would be used as the water source for the Pu conversion facility. Therefore, there should be no impacts to surface water availability.

| [Text deleted.]

During construction of the Pu conversion facility, sanitary wastewater (2.4 million l/yr [0.6 million gal/yr]), would be generated. During operation, a maximum of approximately 15 million l/yr (4 million gal/yr) of

Table 4.3.2.4-1. Potential Changes to Water Resources Resulting From the Plutonium Conversion Facility

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Water Source						
No Action water requirements (million l/yr)	Surface 13,511	Ground 2,400	Ground 7,570	Ground 249	Surface 14,760	Ground 13,247
No Action wastewater discharge (million l/yr)	246	82	540	141	2,277	700
Construction						
Water Availability and Use						
Total water requirement (million l/yr)	2.4	2.4	2.4	2.4	2.4	2.4
Percent increase in projected water use ^a	0.02	0.1	0.03	1.0	0.02	0.02
Water Quality						
Total wastewater discharge (million l/yr)	2.4	2.4	2.4	2.4	2.4	2.4
Percent change in wastewater discharge ^b	1.0	2.9	0.4	1.7	0.1	0.3
Percent change in streamflow	neg	NA	NA	NA	0.005 ^c	0.05 ^d
Operation						
Water Availability and Use						
Total water requirement (million l/yr)	80.5	80.5	80.5	80.5	80.5	80.5
Percent increase in projected water use ^e	0.6	3.4	1.1	32.3	0.6	0.6
Water Quality						
Total wastewater discharge (million l/yr)	15	15	15	15	15	15
Percent change in wastewater discharge ^f	6.1	18.2	2.8	10.6	0.7	2.1
Percent change in streamflow	neg	NA	NA	NA	0.03 ^c	0.3 ^d

Table 4.3.2.4-1. Potential Changes to Water Resources Resulting From the Plutonium Conversion Facility—Continued

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Floodplain						
Is action in 100-year floodplain?	No	No	No	No	No	No
Is critical action in 500-year floodplain?	No	Uncertain	Uncertain	No	No	Unlikely
^a Percent increases in water requirements during construction of a Pu conversion facility are calculated by dividing water requirements for the facility (2.4 million l/yr) with that for No Action water requirements at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 l/yr). ^b Percent increases in wastewater discharged during construction of a Pu conversion facility are calculated by dividing waste water discharges for the facility (2.4 million l/yr) with that for No Action water discharges at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr). ^c Percent changes in stream flow from wastewater discharges are calculated from the average flow of Clinch River (132 m³/s) and East Fork Poplar Creek (1.5 m³/s). The comparison for the East Fork Poplar Creek is shown in the table. ^d Percent changes in stream flow from wastewater discharge are calculated from the minimum flow of the Fourmile Branch (0.16 m³/s). ^e Percent increases in water requirements during operation of a Pu conversion facility are calculated by dividing water requirements for the facility (80.5 million l/yr) with that for No Action water requirements at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr). ^f Percent increases in wastewater discharged during operation of a Pu conversion facility are calculated by dividing wastewater discharges for the facility (15.0 million l/yr) with that for No Action discharges at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).						

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1995a:1; INEL 1995a:1; LANL 1996c; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

sanitary and other wastewater would be discharged to a new wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycle.

Because there are no continuously flowing streams on NTS and no designated floodplains, there are no studies to assess the 500-year floodplain boundaries. Studies of the 100-year floodplain have shown it to be confined to the Jackass Flats and Frenchman Lake area. The site for the Pu conversion facility is not located in either of these areas. However, since the NTS is in a region where most flooding occurs from locally intense thunderstorms that can create brief (less than 6 hours) flash floods, the facility would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater. The Lower and Upper Carbonate, the Volcanic, and the Valley-Fill Aquifers are the sources of water for operations at NTS.

Water requirements for construction of the proposed facilities (2.4 million l/yr [0.6 million gal/yr]), represent approximately 0.006 percent of the minimum estimated annual recharge to the regional aquifer under the entire NTS. This is based on several recent studies that estimated that recharge would be 38 to 57 billion l (10 to 15 billion gal). As shown in Table 4.3.2.4-1, the quantity of water required for construction of the proposed facilities represents approximately a 0.1-percent increase over the total projected No Action groundwater usage. Withdrawal of this additional quantity should have minimal impact on groundwater availability. Operating the proposed facilities at NTS would require 80.5 million l/yr (21.2 million gal/yr) of water, which is approximately 3.4 percent of the projected groundwater usage. This additional withdrawal represents less than 0.2 percent of the estimated minimum annual recharge. No impacts are expected.

Construction and operation of the Pu conversion facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are, therefore, not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the Pu conversion facility. Therefore, there should be no impacts to surface water availability.

[Text deleted.]

During construction of the Pu conversion facility, sanitary wastewater (2.4 million l/yr [0.6 million gal]), would be generated and discharged to the existing wastewater treatment system at the ICPP Area. This amount would represent a 0.4-percent increase in the effluent discharged at INEL. During operation, approximately 15 million l/yr (4 million gal/yr) of sanitary and other wastewater would be discharged to this wastewater treatment system. This amount represents a 2.8-percent increase in INEL's effluent. After treatment, all wastewater generated during construction and operation would be available to recycle or would then be allowed to evaporate to the atmosphere and/or infiltrate to the subsurface. All discharges would be monitored to comply with discharge limits.

The site for the Pu conversion facility is not located in an area historically prone to flooding, but is within the flood zone that could occur as a result of the failure of the MacKay Dam during a maximum probable flood. This

flood event would be more critical than either the 100- or 500-year flood. Because INEL is in a region where flash floods could occur, the facility would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. Construction water requirements for the Pu conversion facilities are small relative to INEL's total usage. Construction and operation water requirements for the facility (2.4 million l/yr [0.6 million gal/yr]), and 80.5 million l/yr (21.2 million gal/yr), respectively, represent 0.03- and 1.1-percent increases over the projected annual groundwater usage. These withdrawals would increase the total projected amount to be pumped at INEL to 17.6 percent of the total allotment during construction and 17.8 percent of the allotment during operation. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). These additional withdrawals should not impact groundwater availability.

Construction and operation of the proposed Pu conversion facility would not result in direct discharges to groundwater and would not be expected to contribute to existing near surface contamination. Treated wastewater that would be discharged to disposal ponds but does not evaporate, however, could percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are, therefore, not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Pantex Plant

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the proposed facility; groundwater would be used as the water source for the Pu conversion facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the Pu conversion facility, sanitary wastewater (2.4 million l/yr [0.6 million gal/yr]), would be generated and discharged to the existing wastewater treatment systems north of Zone 12. During operation, approximately 15 million l/yr (4 million gal/yr) of sanitary wastewater and other wastewater would be discharged to either of these wastewater treatment systems. After treatment, all wastewater generated during construction and operation would be discharged to the playa lakes or would be available for recycle. In 1994, Pantex averaged approximately 1.4 million l/day (0.37 million gal/day) of wastewater discharged to the playas. This quantity is expected to decrease in the future. The expected quantity of additional wastewater potentially discharged to the playas during operation (0.04 million l/day [0.01 million gal/day]) should not cumulatively cause any exceedances of the monthly average limit of 2.46 million l/day (0.65 million gal/day).

The new Pu conversion facility would be located in Zone 12. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in Zone 12, there would be no impacts to flood plains. However, flooding at the playas could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. All water required for construction and operation would be supplied from groundwater using the existing supply system or possibly reclaimed wastewater from the Hollywood Road Wastewater Treatment Plant. Construction water requirements for the Pu conversion facilities are small relative to the recoverable water in aquifer storage which for the year 2010 was estimated to be 287 trillion l (76 trillion gal) (PX WDB 1993a:1). As shown in Table 4.3.2.4-1, construction of the proposed Pu conversion facility would require 2.4 million l/yr (0.6 million gal/yr) of water, which represents approximately a 1.0-percent increase over the projected annual groundwater usage. [Text deleted.] Water required for operations (80.5 million l/yr [21.2 million gal/yr]) would increase projected water requirements by 32.3 percent. Previous studies have

shown that when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala Aquifer, an average of 1.8-m/yr (5.9-ft/yr) decline in the water table occurred over a 10-yr period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the proposed Pu conversion facility at Pantex would require 80.5 million l/yr (21.2 million gal/yr), resulting in a small drawdown representing 4.2 percent of the capacity of the groundwater system. Although this additional groundwater withdrawal would add to the existing decline in water levels of the Ogallala Aquifer, the estimated degree would not affect regional groundwater levels. The total site groundwater withdrawal including this facility would be 329 million l/yr (86.9 million gal/yr) which, because of expected cutbacks in other programs, would be 61 percent less than the 836 million l/yr (221 million gal/yr) currently being withdrawn from wells at Pantex.

Construction and operation of the proposed Pu conversion facility would not result in direct discharges to groundwater. Treated wastewater discharged to playas, however, could percolate downward into the groundwater of the near surface aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified by the TNRCC. [Text deleted.]

Although the expected drawdowns caused by withdrawing the water required for this alternative is small, the overall decline in groundwater levels in the Amarillo are is of concern. Possible groundwater conservation measures at Pantex that could be considered including decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Oak Ridge Reservation

Surface Water. Water required for construction and operation of the Pu conversion facility would be provided via existing distribution systems. The source of this water is the Clinch River and its tributaries. Water requirements during construction (2.4 million l/yr [0.6 million gal/yr]) and operation (80.5 million l/yr [21.2 million gal/yr]) would represent a 0.02-percent and 0.6-percent increase respectively in the projected annual surface water withdrawal. These additional water withdrawals from the Clinch River should cause negligible impacts to surface water availability.

During construction of the Pu conversion facility, sanitary wastewater (approximately 2.4 million l/yr [0.6 million gal/yr]) would be generated and discharged to the existing wastewater treatment system in the Y-12 area. This would cause a 0.1-percent increase in the effluent from this facility. During operation, a total of 15 million l/yr (3.9 million gal/yr) of wastewater would be generated by the new facilities. This would cause a 0.7-percent increase in the effluent discharged from the Y-12 area. All discharges would be monitored to comply with discharge requirements. Minimal impacts would be expected.

Since the potential site for the Pu conversion facility would be located outside both the 500- and 100-year floodplains, there would be no impacts to floodplains.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater; therefore, neither groundwater quality nor availability would be affected.

Savannah River Site

Surface Water. No surface water would be used for project requirements during construction and operation of the Pu conversion facility. [Text deleted.]

During construction of the Pu conversion facility, sanitary wastewater (2.4 million l/yr [0.6 million gal/yr]) would be generated and discharged to the sitewide wastewater treatment system, which would not require any modifications. This amount would represent a 0.3-percent increase in the estimated annual flow to this facility and could be handled within the existing capacity. During operation, a total of 15 million l/yr (3.9 million gal/yr) of wastewater would be generated by the new facility, representing a 2.1-percent increase. [Text deleted.]

The potential location of the Pu conversion facility would be located outside the 100-year floodplain. Information on the location of the 500-year floodplain at SRS is only available for a limited number of project areas. However, the Pu Conversion facility at SRS would not likely affect, or be affected by the 500-year floodplain of either the Fourmile Branch or Upper Three Runs Creek because the facility would be located at an elevation of about 91 m (300 ft) above MSL and is approximately 33 m (107 ft) and 64 m (210 ft) above these streams and at distances from these streams of 0.8 km (0.5 mi) to 1.5 km (0.94 mi), respectively. The maximum flow that has occurred on the Upper Three Runs Creek was in 1990, with a flow rate of about 58 m³/s (2,040 ft³/s). At that time the creek reached an elevation of almost 30 m (98 ft) above MSL (SR USGS 1996a:1). The elevations of the buildings in F-Area are more than 62 m (202 ft) above the highest flow elevation of the Upper Three Runs Creek. The maximum flow that has occurred on the Fourmile Branch was in 1991 with a rate of approximately 5 m³/s (186 ft³/s), and an elevation of about 61 m (199 ft) above MSL (SR USGS 1996a:1). Elevations of the buildings in F-Area are more than approximately 31 m (101 ft) higher than the maximum flow level that has occurred.

Groundwater. During construction, the quantity of water required would be approximately 2.4 million l/yr (0.6 million gal/yr), which would represent a 0.02-percent increase over the existing projected annual ground water withdrawal. During operation, water requirements would be approximately 80.5 million l/yr (21.2 million gal/yr), which would represent a 0.6-percent increase in ground water withdrawals. Minimal impacts to groundwater availability are expected.

No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected.

[Text deleted.]

4.3.2.5 Geology and Soils

This section describes the environmental impacts to the geologic and soil resource as related to the construction and operation of the Pu conversion facility. A Pu conversion facility, at any of the sites analyzed, would involve some ground-disturbing construction activities (36 ha [90 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. The relative amount of annual precipitation (rainfall) is greater at ORR and SRS than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on the geologic resource are anticipated. Neither facility construction and operational activities nor site infrastructure improvements would restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is low for Pantex, Hanford, INEL, and NTS. The soil erosion potential for ORR and SRS during construction and operational activities is moderate due primarily to the greater relative annual precipitation. Soil disturbance would occur primarily from ground-disturbing construction activities (foundation preparation) and associated building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind (increases in wind velocity and duration increase potential soil erosion), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvement (buildings, roads, and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal.

[Text deleted.]

4.3.2.6 Biological Resources

Construction of the Pu conversion facility would disturb 36 ha (90 acres) of land at each of the DOE sites analyzed. This includes areas on which plant facilities would be constructed, as well as areas to be used for construction laydown. Consultation with USFWS and State agencies would be conducted at the site-specific level as appropriate to avoid potential impacts to threatened and endangered species, and other protected species and habitat.

Hanford Site

It is assumed that the Pu conversion facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the Pu conversion facility would result in the disturbance of terrestrial habitat equaling about 0.02 percent of Hanford. This includes areas on which plant facilities would be constructed as well as areas that would be revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. The facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the Pu conversion facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the Pu conversion facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the Pu conversion facility would not affect wetlands since no wetlands exist near the assumed facility location. Since water would be withdrawn from the Columbia River through an existing intake structure and wastewater would be discharged to evaporation/infiltration ponds, wetlands would not be affected by placement of intake and discharge structures.

Aquatic Resources. Construction of a Pu conversion facility at Hanford would not impact aquatic resources since there are no surface water bodies near the assumed facility location. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure so impacts to aquatic resources from impingement and entertainment would be minimal. Since the volume of water included represents a small percentage of the flow of the river, flow-related impacts to aquatic resources would be minimal. Wastewater would be discharged to evaporation/infiltration ponds; therefore, aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the Pu conversion facility; however, sagebrush habitat would be disturbed. The sagebrush community is important nesting/breeding and foraging habitat for several State-listed and candidate species such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the Pu conversion facility would be located in the Frenchman Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are described below.

Terrestrial Resources. Construction and operation of the Pu conversion facility at NTS would result in the disturbance of terrestrial resources equaling about 0.01 percent of NTS. This includes areas on which plant facilities would be constructed as well as areas that would be revegetated following construction. Vegetative cover within the assumed facility location, which is primarily creosote bush (Figure 3.3.6-1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the Pu conversion facility would affect animal populations. Less mobile animals, such as reptiles and small mammals, within the project area would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the Pu conversion facility would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the Pu conversion facility would not affect aquatic resources because there are no permanent surface water bodies near the facility location.

Threatened and Endangered Species. The threatened desert tortoise is a federally listed species that could be affected by construction of the Pu conversion facility at NTS. Construction activities such as land clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicular traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training, putting restrictions on vehicle speeds and off-road movement, conducting clearance surveys prior to surface disturbance, approving stop work authority if tortoises are found within work areas, removing tortoises from roadways and work areas, placing permanent and temporary tortoise proof fencing around trenches, landfills, and treatment ponds, inspecting trenches, and having biologists survey when heavy equipment is in use. The

USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the Pu conversion facility.

[Text deleted.]

Any listed plant species (Table 3.3.6-1) located within the construction area would be lost during land-clearing activities. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicular traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on the NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the Pu conversion facility (Section 4.3.2.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that the Pu conversion facility would be constructed within an undeveloped portion of the ICPP area. The ICPP area falls within the big sagebrush/thickspike wheatgrass/needle-and-thread grass community. Impacts to wildlife would be limited to smaller mammals and some birds and reptiles which could be displaced or suffer mortality. Larger mammals are excluded from the assumed facility location by the perimeter fence and thus would not be impacted. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the area would have already adapted to similar disturbances. Due to the lack of wetlands or aquatic resources near the assumed facility location, these resources would not be affected by construction or operation of the Pu conversion facility. Since the new facility would be located within the ICPP security area, impacts to threatened and endangered species would not be expected since they are not present at the ICPP.

Pantex Plant

It is assumed that the Pu conversion facility would be located within Zone 12 which is a developed area that lacks natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the assumed facility location; however, small mammals and some birds and reptiles could be displaced by construction. Since the area does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the Pu conversion facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional wastewater could lead to a minor increase in open water near the outfall, as well as a slight change in plant species composition. No federally listed threatened or endangered species would be affected by construction or operation of the Pu conversion facility. Although the assumed facility location has been disturbed, it is possible that the State-listed Texas horned lizard could be present. Preactivity surveys would be conducted as appropriate prior to construction.

Oak Ridge Reservation

It is assumed that the Pu conversion facility would be constructed on a disturbed area within Y-12. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to Y-12 would have already adapted to similar disturbance. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since water would be taken from existing sources and discharged via NPDES permitted outfalls and would involve minor volumes. Construction and operation of the Pu conversion facility would not be expected

to impact threatened and endangered species due to the developed nature of the assumed facility location. Impacts to the Tennessee dace (State deemed in need of management) would not be expected since erosion would be controlled and discharges would be through permitted outfalls.

Savannah River Site

It is assumed that the Pu conversion facility would be constructed within the F-Area, which is one of the highly developed industrial areas of the SRS. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area would have already adapted to similar disturbances. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since minor volumes of water would be taken from existing sources and discharged via NPDES-permitted outflows. Impacts from construction and operation of the Pu conversion facility would not be expected to impact threatened and endangered species due to the developed nature of the assumed facility location. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the site that this species would not be directly affected by this action.

4.3.2.7 Cultural and Paleontological Resources

This section discusses potential impacts to cultural and paleontological resources that may result from the construction and operation of the Pu conversion facility at each of the representative sites analyzed. The total land disturbance for this facility is 36 ha (90 acres) during construction, of which 28 ha (70 acres) would be used during operation. A 1.6-km (1-mi) reduced-access buffer zone would be created around the facility, except ORR which would have a reduced buffer zone at the site. The buffer zone would be contained within existing boundaries at all sites. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, building modification, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources were identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. Any such sites may be identified through additional surveys. Any identified sites would be avoided. Operation would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified close to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The Pu conversion facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed lands necessary for the proposed facility may contain similar prehistoric or historic resources. Impacts to resources would occur during construction, but not the operation, of the facility.

The CGTO conducted surveys over portions of Frenchman Flat and has identified at least 20 plant species of importance to Native Americans there. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from the construction and operation of the facility. Potential impacts may include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological resources may be affected by construction, but not operation, of the facility.

Idaho National Engineering Laboratory

The Pu conversion facility would be constructed within the existing ICPP security area. The facility would be sited in a location previously approved for the construction of the Special Isotope Separation Project. An associated surface survey identified no sites within the proposed project area. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archaeological remains be discovered during construction. Two historic sites occur adjacent to the ICPP—one historic can scatter across the Big Lost River, to the northeast, and one abandoned homestead to the east. The can scatter is not considered eligible for NRHP listing and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed action. Facility construction and operation may have a visual or auditory impact on traditional use areas or sacred sites. Resources may be identified through consultation with the interested tribes.

Some paleontological resources may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain which have produced fossilized remains. Operation would not have an effect on paleontological resources.

Pantex Plant

The Pu conversion facility would be constructed in Zone 12. A surface survey of the plant was completed in 1981. No prehistoric or historic resources were identified in Zone 12 except for 12 remaining World War II Era structures, some of which may be potentially NRHP eligible. Although it is possible that subsurface remains exist within Pantex boundaries, Zone 12 is disturbed and probably does not contain any intact archaeological sites. Consequently, impacts to prehistoric and historic resources are not anticipated. [Text deleted.] Should any resources be discovered during testing or construction, mitigation measures would be taken in consultation with the Texas SHPO. Operation of the facility would not result in additional impacts to prehistoric or historic resources.

DOE has initiated a public outreach program to involve Native American groups in decision-making related to land use and cultural resources. Native American resources such as cemeteries may be affected by new construction. Facility operation may have an auditory or visual impact on sacred or ceremonial sites. To date, none of the Native American tribes known to have traditional interest in Pantex lands have identified any resources in Zone 12. Some may be identified through additional consultation.

Important paleontological remains such as bison and camel bones have been found in other areas of the High Plains. It is possible that some of the land to be affected by construction may contain fossilized remains. Operation would not affect paleontological resources because it does not involve additional ground disturbance.

Oak Ridge Reservation

The facility would be constructed within Y-12. Because most of Y-12 is already developed or disturbed, construction and operation would not affect prehistoric or historic sites. No Native American resources have been identified at Y-12, so impacts to these resources are not expected to result from the construction or operation of the proposed facility. Paleontological resources at ORR include common invertebrate fossils with relatively low research potential, so any impacts to them would be considered negligible.

Savannah River Site

The location for the Pu conversion facility is on open space within F-Area. Portions of F-Area have been surveyed and contain sites potentially eligible for the NRHP. Additional surveys would be conducted in any unsurveyed areas to be disturbed by construction. Site types known to occur at SRS include remains of prehistoric base camps, quarries, and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by facility construction, but not operation.

Some Native American resources may be affected by the proposed action. Resources such as prehistoric sites, cemeteries, and traditional plants could be affected by construction. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to such areas may also result. Any resources would be identified through consultation with the potentially affected tribes.

No scientifically valuable fossil remains have been recorded at SRS to date. Facility construction and operation are not expected to affect paleontological resources.

[Text deleted.]

4.3.2.8 Socioeconomics

This section analyzes the socioeconomic effects of the Pu conversion facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. The effects at all candidate sites are found in the Supplemental Socioeconomic Data Report (Socio 1996a).

Regional Economy Characteristics. Constructing a Pu conversion facility at any of the sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 358 workers during the peak year of construction at any site. The largest increase in regional employment (less than 1 percent) among the sites analyzed would be at INEL. A total of 727 new jobs (358 direct and 369 indirect) would be generated and regional unemployment would fall from 5.4 percent to 4.9 percent. The largest increase in regional per capita income would also occur at INEL during the construction of the facility, but the increase would be much less than 1 percent over No Action (Socio 1996a).

Operating the facility would generate greater socioeconomic changes than would construction, due to the larger, more permanent workforce. A workforce of 883 would be required for full operation at any site. Implementing the alternative at INEL would generate the largest changes in regional employment (about 2 percent) and per capita income (about 1 percent). A total of 3,251 new jobs (883 direct and 2,368 indirect) would be created by the operational activities, and INEL regional unemployment would fall to 3.7 percent (Socio 1996a).

Population and Housing. At all of the sites analyzed, construction employment requirements would be met by the available resident labor force, but some in-migrating workers would be needed to fill more specialized positions during operations. Locating the facility at Pantex would induce the largest population increase among the sites analyzed. However, project-related immigration would increase the ROI population by only about 1 percent over No Action population projections. Housing units, in excess of existing vacancies, may be required at all of the sites analyzed, except NTS and ORR, to accommodate the population growth. The greatest increase would occur in the INEL ROI, but this would be less than 1 percent over No Action projections. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the population growth at all of the sites analyzed (Socio 1996a).

Community Services. During construction, there would be minimal impacts to community services in the ROIs of any of the sites analyzed. However, operation of the facility would slightly increase the demand for community services. The effects of population growth due to in-migrating workers during operations would be minor at all sites analyzed. The following discussion focuses on the Pantex and INEL ROIs, which would experience the greatest increases in demand for community services.

To maintain the No Action student-to-teacher ratio of 16.3:1 in the Pantex ROI, 19 new teachers would be needed during operation of the proposed facility. The increase in teacher requirements, however, would be distributed over several school districts in the ROI; therefore, no single school district would be significantly affected (Socio 1996a).

To maintain the No Action service level of 1.6 sworn police officers per 1,000 persons in the INEL ROI, 2 new officers would be needed. Four additional firefighters would be required to sustain the No Action service level of 2.3 firefighters per 1,000 persons in the Pantex ROI (Socio 1996a).

Projected hospital occupancy rates would increase slightly over No Action levels. However, projected capacities would be capable of accommodating these small increases in patient load. To maintain the No Action service level of 2.0 physicians per 1,000 persons, 3 additional physicians would be needed in the Pantex ROI during full operation (Socio 1996a).

Local Transportation. Traffic generated from construction of the Pu conversion facility would not affect the level of service on the local road segments analyzed at any of the sites. However, traffic generated during

operations at INEL would cause a drop in the level of service on one road segment. U.S. 20/26 from U.S. 26 East to ID 22/33 would drop from level of service B to C (Socio 1996a).

4.3.2.9 Public and Occupational Health and Safety

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the Pu conversion facility, whose activities are common to Pu disposition alternatives. The section first describes the impacts from normal facility operation at each potential site followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation are presented in Tables 4.3.2.9-1 and 4.3.2.9-2, respectively. Impacts from hazardous chemicals to these same groups are given in Table 4.3.2.9-3. Summaries of impacts associated with postulated accidents are given in Tables 4.3.2.9-4 through 4.3.2.9-9. Detailed results are presented in Section M.

Normal Operation. There would be no radiological releases associated with the construction of a new Pu conversion facility at any of the sites. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the new Pu conversion facility at each of the sites are presented in Table 4.3.2.9-1. The impacts from all site operations, including the new Pu conversion facility, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The doses to the maximally exposed member of the public from annual Pu conversion facility operation would range from 9.5×10^{-5} mrem at NTS site to 9.2×10^{-3} mrem at ORR. From 10 years of operation, the corresponding risks of fatal cancer to this individual would range from 4.8×10^{-10} to 4.6×10^{-8} . The impacts to the average individual would be less. As a result of annual facility operation, the population doses would range from 1.9×10^{-4} person-rem at NTS site to 0.074 person-rem at ORR. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 9.5×10^{-7} to 3.7×10^{-4} .

The doses to the maximally exposed member of the public from annual total site operations are all within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would range from 7.0×10^{-4} mrem at Pantex to 3.2 mrem at ORR. From 10 years of operation, the corresponding risks of fatal cancers to this individual would range from 3.5×10^{-9} to 1.6×10^{-5} . The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operation, the population doses would be within the limit given in proposed 10 CFR 834, and would range from 3.9×10^{-3} person-rem at NTS to 44 person-rem at SRS. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 2.0×10^{-5} to 0.22.

Doses to onsite workers from normal operations are given in Table 4.3.2.9-2. Included are involved workers directly associated with the new Pu conversion facility, workers who are not involved with the Pu conversion facility, and the entire workforce at each site. All doses fall within regulatory limits.

The annual dose to Pu conversion facility workers is site-independent and would be 233 mrem to the average facility worker and 133 person-rem to the entire facility workforce. The annual dose to the average noninvolved worker would range from 2.6 mrem at ORR to 32 mrem at SRS. The annual total dose to all noninvolved workers would range from 3.0 person-rem at the NTS site to 250 person-rem at the Hanford site. The annual

Table 4.3.2.9-1. Potential Radiological Impacts to the Public During Normal Operation of the Plutonium Conversion Facility

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a
Annual Dose to the Maximally Exposed Individual Member of the Public^b												
Atmospheric release pathway (mrem)	1.8x10 ⁻⁴	4.4x10 ⁻³	9.5x10 ⁻⁵	4.2x10 ⁻³	1.2x10 ⁻⁴	0.018	6.9x10 ⁻⁴	7.0x10 ⁻⁴	9.2x10 ⁻³	1.5	1.0x10 ⁻³	0.42
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0	0	0.1	0	0.081
Total liquid release pathway (mrem)	0	9.5x10 ⁻⁴	0	0	0	0	0	0	0	1.7	0	0.37
Atmospheric and liquid release pathways combined (mrem)	1.8x10 ⁻⁴	5.4x10 ⁻³	9.5x10 ⁻⁵	4.2x10 ⁻³	1.2x10 ⁻⁴	0.018	6.9x10 ⁻⁴	7.0x10 ⁻⁴	9.2x10 ⁻³	3.2	1.0x10 ⁻³	0.79
Percent of natural background ^c	6.0x10 ⁻⁵	1.8x10 ⁻³	3.0x10 ⁻⁵	1.3x10 ⁻³	3.6x10 ⁻⁵	5.3x10 ⁻³	2.1x10 ⁻⁴	2.1x10 ⁻⁴	3.1x10 ⁻³	1.1	3.4x10 ⁻⁴	0.27
10-year fatal cancer risk	9.0x10 ⁻¹⁰	2.7x10 ⁻⁸	4.8x10 ⁻¹⁰	2.1x10 ⁻⁸	6.0x10 ⁻¹⁰	8.9x10 ⁻⁸	3.5x10 ⁻⁹	3.5x10 ⁻⁹	4.6x10 ⁻⁸	1.6x10 ⁻⁵	5.0x10 ⁻⁹	4.0x10 ⁻⁶
[Text deleted.]												
Annual Population Dose Within 80 Kilometers^d												
From atmospheric release pathway (person-rem)	8.4x10 ⁻³	0.47	1.9x10 ⁻⁴	3.9x10 ⁻³	1.2x10 ⁻³	2.4	3.8x10 ⁻³	4.1x10 ⁻³	0.074	29	0.066	41
From total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	4.7	0	3.6
From atmospheric and liquid release pathways combined (person-rem)	8.4x10 ⁻³	1.6	1.9x10 ⁻⁴	3.9x10 ⁻³	1.2x10 ⁻³	2.4	3.8x10 ⁻³	4.1x10 ⁻³	0.074	34	0.066	44
Percent of natural background ^c	4.5x10 ⁻⁶	8.4x10 ⁻⁴	2.1x10 ⁻⁶	4.2x10 ⁻⁵	1.3x10 ⁻⁶	2.7x10 ⁻³	3.3x10 ⁻⁶	3.5x10 ⁻⁶	2.0x10 ⁻⁵	9.0x10 ⁻³	2.5x10 ⁻⁵	0.017
10-year fatal cancers	4.2x10 ⁻⁵	7.8x10 ⁻³	9.5x10 ⁻⁷	2.0x10 ⁻⁵	6.0x10 ⁻⁶	0.012	1.9x10 ⁻⁵	2.0x10 ⁻⁵	3.7x10 ⁻⁴	0.17	3.3x10 ⁻⁴	0.22
[Text deleted.]												

Table 4.3.2.9-1. Potential Radiological Impacts to the Public During Normal Operation of the Plutonium Conversion Facility—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site ^a	Facility	Total Site ^a	Facility	Total Site ^a	Facility	Total Site ^a	Facility	Total Site ^a	Facility	Total Site ^a
Annual Dose to the Average Individual Within 80 Kilometers^c												
Atmospheric and liquid release pathways combined (mrem)	1.4x10 ⁻⁵	2.6x10 ⁻³	6.5x10 ⁻⁶	1.3x10 ⁻⁴	4.5x10 ⁻⁶	8.9x10 ⁻³	1.1x10 ⁻⁵	1.2x10 ⁻⁵	5.8x10 ⁻⁵	0.026	7.4x10 ⁻⁵	0.049
10-year fatal cancer risk	6.8x10 ⁻¹¹	1.3x10 ⁻⁸	3.2x10 ⁻¹¹	6.6x10 ⁻¹⁰	2.2x10 ⁻¹¹	4.5x10 ⁻⁸	5.5x10 ⁻¹¹	6.0x10 ⁻¹¹	2.9x10 ⁻¹⁰	1.3x10 ⁻⁷	3.7x10 ⁻¹⁰	2.5x10 ⁻⁷
[Text deleted.]												

^a Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9). The location of the MEI may be different under No Action than for operation of the new Pu conversion facility. Therefore, the impacts may not be directly additive.

^b The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways as required by NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway as required by the SDWA, and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

^c The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem; the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem; the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem; the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem; the population within 80 km receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem; the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem; the population within 80 km receives 266,000 person-rem.

^d For DOE activities proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose exceeds 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

^e Obtained by dividing the population dose by the number of people projected to be living within the 80 km of the site (621,000 at Hanford; 29,400 at NTS; 269,000 at INEL; 350,000 at Pantex; 1,285,000 at ORR; and 893,000 at SRS).

Source: Section M.2.

Table 4.3.2.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Plutonium Conversion Facility

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce^a						
Average worker dose (mrem/yr) ^b	233	233	233	233	233	233
10-year risk of fatal cancer [Text deleted.]	9.3x10 ⁻⁴	9.3x10 ⁻⁴	9.3x10 ⁻⁴	9.3x10 ⁻⁴	9.3x10 ⁻⁴	9.3x10 ⁻⁴
Total dose (person-rem/yr)	133	133	133	133	133	133
10-year fatal cancers [Text deleted.]	0.53	0.53	0.53	0.53	0.53	0.53
Noninvolved Workforce^c						
Average worker dose (mrem/yr) ^b	27	5.0	30	10	2.6	32
10-year risk of fatal cancer [Text deleted.]	1.1x10 ⁻⁴	2.0x10 ⁻⁵	1.2x10 ⁻⁴	4.0x10 ⁻⁵	1.0x10 ⁻⁵	1.3x10 ⁻⁴
Total dose (person-rem/yr)	250	3.0	220	14	44	226
10-year fatal cancers [Text deleted.]	1.0	0.012	0.88	0.056	0.18	1.9
Total Site Workforce^d						
Dose (person-rem/yr)	383	136	353	147	177	359
10-year fatal cancers [Text deleted.]	1.5	0.54	1.4	0.59	0.71	1.4

^a The involved worker is a worker associated with operations of the proposed action.

^b The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

^c The noninvolved worker is a worker onsite but not associated with operations of the proposed action. The noninvolved workforce is equivalent to the No Action workforce.

^d The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.
[Text deleted.]

Source: Section M.2.

dose to the total site workforce would range from 136 person-rem at the NTS site to 383 person-rem at Hanford. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.2.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts from normal operation of the Pu conversion facility at several sites are presented in Table 4.3.2.9–3. Included are the impacts due to operation of the Pu stabilization and conversion facility, and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected, and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI ranges from 4.3×10^{-6} at the NTS site to 6.2×10^{-4} at INEL due to the Pu conversion facility operation. The cancer risk from hazardous chemicals to the MEI ranges from 4.7×10^{-9} at NTS to 1.9×10^{-7} at ORR. The HI to the onsite worker ranges from 8.0×10^{-4} at Pantex to 3.3×10^{-3} at ORR, and the cancer risk to the onsite worker ranges from 7.2×10^{-6} at Pantex to 1.5×10^{-5} at the ORR site.

Facility Accidents. A set of potential accidents have been postulated for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Tables 4.3.2.9–4 through 4.3.2.9–9 for the sites analyzed (Hanford, NTS, INEL Pantex, ORR, and SRS). In the event that the site boundary is less than 1,000 m (3,280 ft) from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 1.6 at ORR for the oxyacetylene explosion in a process cell accident scenario with a probability of 1.0×10^{-7} per year. The corresponding 10-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 1.6×10^{-6} , 9.8×10^{-9} , and 7.9×10^{-9} , respectively. The maximum population 10-year facility lifetime risk would be 1.3×10^{-4} (that is, one fatality in about 7,500 years) at ORR for the fire on the loading dock accident scenario with a probability of 5.0×10^{-4} per year. The corresponding maximum offsite individual and worker 10-year facility lifetime risks would be 7.0×10^{-7} and 5.6×10^{-7} , respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.2.9–4 through 4.3.2.9–9.

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas to minimize the risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new disposition facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is the possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

An indication of the magnitude of the impacts of an aircraft crash into a disposition facility is given by the earthquake scenario. The earthquake and aircraft crash scenarios are similar in that they both result in major structural damage and the release of plutonium directly to the environment. They differ in that an earthquake-induced fire is based on limited combustible materials while the aircraft crash has the potential for a major fuel related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the

Table 4.3.2.9-3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Plutonium Conversion Facility

Receptor	Hanford		INEL		NTS		ORR		Pantex		SRS	
	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b
Maximally Exposed Individual (Public)												
Hazard Index ^c	2.9x10 ⁻⁵	9.1x10 ⁻⁵	6.2x10 ⁻⁴	0.015	4.3x10 ⁻⁶	1.7x10 ⁻⁶	3.3x10 ⁻⁴	0.040	1.6x10 ⁻⁴	5.8x10 ⁻³	7.9x10 ⁻⁶	5.2x10 ⁻³
Cancer Risk ^d	3.2x10 ⁻⁸	3.2x10 ⁻⁸	6.8x10 ⁻⁸	3.7x10 ⁻⁶	4.7x10 ⁻⁹	1.9x10 ⁻⁹	1.9x10 ⁻⁷	1.9x10 ⁻⁷	1.8x10 ⁻⁷	1.9x10 ⁻⁷	8.7x10 ⁻⁹	1.4x10 ⁻⁷
Worker Onsite												
Hazard Index ^e	1.6x10 ⁻³	5.6x10 ⁻³	1.6x10 ⁻³	0.23	8.3x10 ⁻⁴	1.7x10 ⁻⁴	3.3x10 ⁻³	0.16	8.0x10 ⁻⁴	6.9x10 ⁻³	1.4x10 ⁻³	1.2
Cancer Risk ^f	1.4x10 ⁻⁵	1.4x10 ⁻⁵	1.4x10 ⁻⁵	7.8x10 ⁻⁴	7.4x10 ⁻⁶	7.4x10 ⁻⁶	1.5x10 ⁻⁵	1.5x10 ⁻⁵	7.2x10 ⁻⁶	7.7x10 ⁻⁶	1.3x10 ⁻⁵	2.1x10 ⁻⁴

^a Facility=contribution from the proposed new facility operation only.

^b Total=includes the contributions from the No Action and the proposed new facility operation.

^c Hazard Index for MEI=sum of individual Hazard Quotients (noncancer health effects) for MEI.

^d Cancer Risk for MEI=(emissions concentrations) x (0.286 [converts concentrations to doses]) x (Slope Factor).

^e Hazard Index for workers=sum of individual Hazard Quotients (noncancer health effects) for workers.

^f Cancer Risk for workers=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (Slope Factor).

Source: Section M.3, Tables M.3.4-34 through M.3.4-39.

Table 4.3.2.9-4. Plutonium Conversion Facility Accident Impacts at Hanford Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c	Accident Frequency (per yr)
Fire on the loading dock	4.8x10 ⁻⁷	9.7x10 ⁻⁵	1.9x10 ⁻⁸	3.8x10 ⁻⁶	3.5x10 ⁻⁵	7.0x10 ⁻³	5.0x10 ⁻⁴
Fire in the process cell	5.8x10 ⁻¹³	5.8x10 ⁻¹⁰	2.3x10 ⁻¹⁴	2.3x10 ⁻¹¹	4.2x10 ⁻⁹	4.2x10 ⁻⁶	1.0x10 ⁻⁴
Deflagration inside a glovebox	1.2x10 ⁻¹⁰	1.2x10 ⁻⁷	4.8x10 ⁻¹²	4.8x10 ⁻⁹	8.7x10 ⁻⁹	8.7x10 ⁻⁶	1.0x10 ⁻⁴
Forklift breach of containment	9.2x10 ⁻¹⁷	2.0x10 ⁻¹³	3.7x10 ⁻¹⁸	8.2x10 ⁻¹⁵	6.7x10 ⁻¹⁵	1.5x10 ⁻¹¹	4.5x10 ⁻⁵
Nuclear criticality	2.1x10 ⁻¹³	2.1x10 ⁻⁷	8.4x10 ⁻¹⁵	8.4x10 ⁻⁹	1.7x10 ⁻¹²	1.7x10 ⁻⁶	1.0x10 ⁻⁷
Beyond evaluation basis fire in a process cell	4.1x10 ⁻¹²	4.1x10 ⁻⁶	1.6x10 ⁻¹³	1.6x10 ⁻⁷	3.0x10 ⁻¹⁰	3.0x10 ⁻⁴	1.0x10 ⁻⁷
Oxyacetylene explosion in a process cell	6.8.x10 ⁻⁹	6.8x10 ⁻³	2.4x10 ⁻¹⁰	2.4x10 ⁻⁴	4.4x10 ⁻⁷	0.44	1.0x10 ⁻⁷
Beyond evaluation basis earthquake	3.1x10 ⁻⁹	3.1x10 ⁻³	1.2x10 ⁻¹⁰	1.2x10 ⁻⁴	2.2x10 ⁻⁷	0.22	1.0x10 ⁻⁷
Expected risk ^d	4.9x10 ⁻⁷	-	2.0x10 ⁻⁸	-	3.6x10 ⁻⁵	-	-

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.9.1-4 and M.5.3.9.1-5 and the MACCS computer code.

Table 4.3.2.9-5. Plutonium Conversion Facility Accident Impacts at Nevada Test Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c
Fire on the loading dock	3.3x10 ⁻⁷	6.6x10 ⁻⁵	7.6x10 ⁻⁹	1.5x10 ⁻⁶	7.9x10 ⁻⁷	1.6x10 ⁻⁴
Fire in the process cell	4.0x10 ⁻¹³	4.0x10 ⁻¹⁰	9.1x10 ⁻¹⁵	9.1x10 ⁻¹²	9.5x10 ⁻¹³	9.5x10 ⁻¹⁰
Deflagration inside a glovebox	8.2x10 ⁻¹¹	8.2x10 ⁻⁸	1.9x10 ⁻¹²	1.9x10 ⁻⁹	2.0x10 ⁻¹⁰	2.0x10 ⁻⁷
Forklift breach of containment	6.3x10 ⁻¹⁷	1.4x10 ⁻¹³	1.4x10 ⁻¹⁸	3.2x10 ⁻¹⁵	1.5x10 ⁻¹⁶	3.4x10 ⁻¹³
Nuclear criticality	1.5x10 ⁻¹³	1.5x10 ⁻⁷	3.2x10 ⁻¹⁵	3.2x10 ⁻⁹	3.3x10 ⁻¹⁴	3.3x10 ⁻⁸
Beyond evaluation basis fire in a process cell	2.8x10 ⁻¹²	2.8x10 ⁻⁶	6.4x10 ⁻¹⁴	6.4x10 ⁻⁸	6.7x10 ⁻¹²	6.7x10 ⁻⁶
Oxyacetylene explosion in a process cell	4.5x10 ⁻⁹	4.5x10 ⁻³	9.4x10 ⁻¹¹	9.4x10 ⁻⁵	9.9x10 ⁻⁹	9.9x10 ⁻³
Beyond evaluation basis earthquake	2.1x10 ⁻⁹	2.1x10 ⁻³	4.7x10 ⁻¹¹	4.7x10 ⁻⁵	4.9x10 ⁻⁹	4.9x10 ⁻³
Expected risk ^d	3.4x10 ⁻⁷	-	7.7x10 ⁻⁹	-	8.1x10 ⁻⁷	-

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.9.1-4 and M.5.3.9.1-5 and the MACCS computer code.

Table 4.3.2.9-6. Plutonium Conversion Facility Accident Impacts at Idaho National Engineering Laboratory

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c
Fire on the loading dock	4.5x10 ⁻⁷	9.0x10 ⁻⁵	4.9x10 ⁻⁹	9.7x10 ⁻⁷	1.0x10 ⁻⁵	2.1x10 ⁻³
Fire in the process cell	5.4x10 ⁻¹³	5.4x10 ⁻¹⁰	5.8x10 ⁻¹⁵	5.8x10 ⁻¹²	1.3x10 ⁻¹¹	1.3x10 ⁻⁸
Deflagration inside a glovebox	1.1x10 ⁻¹⁰	1.1x10 ⁻⁷	1.2x10 ⁻¹²	1.2x10 ⁻⁹	2.6x10 ⁻⁹	2.6x10 ⁻⁶
Forklift breach of containment	8.6x10 ⁻¹⁷	1.9x10 ⁻¹³	9.3x10 ⁻¹⁹	2.1x10 ⁻¹⁵	2.0x10 ⁻¹⁵	4.5x10 ⁻¹²
Nuclear criticality	2.0x10 ⁻¹³	2.0x10 ⁻⁷	1.9x10 ⁻¹⁵	1.9x10 ⁻⁹	4.3x10 ⁻¹³	4.3x10 ⁻⁷
Beyond evaluation basis fire in a process cell	3.8x10 ⁻¹²	3.8x10 ⁻⁶	4.1x10 ⁻¹⁴	4.1x10 ⁻⁸	8.9x10 ⁻¹¹	8.9x10 ⁻⁵
Oxyacetylene explosion in a process cell	6.9x10 ⁻⁹	6.9x10 ⁻³	6.1x10 ⁻¹¹	6.1x10 ⁻⁵	1.3x10 ⁻⁷	0.13
Beyond evaluation basis earthquake	2.8x10 ⁻⁹	2.8x10 ⁻³	3.0x10 ⁻¹¹	3.0x10 ⁻⁵	6.5x10 ⁻⁸	0.065
Expected risk ^d	4.6x10 ⁻⁷	—	5.0x10 ⁻⁹	—	1.1x10 ⁻⁵	—
						1.0x10 ⁻⁷
						—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.9.1-4 and M.5.3.9.1-5 and the MACCS computer code.

Table 4.3.2.9-7. Plutonium Conversion Facility Accident Impacts at Pantex Plant

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c	Accident Frequency (per yr)
Fire on the loading dock	1.9x10 ⁻⁷	3.9x10 ⁻⁵	7.7x10 ⁻⁸	1.5x10 ⁻⁵	1.2x10 ⁻⁵	2.4x10 ⁻³	5.0x10 ⁻⁴
Fire in the process cell	2.3x10 ⁻¹³	2.3x10 ⁻¹⁰	9.3x10 ⁻¹⁴	9.3x10 ⁻¹¹	1.4x10 ⁻¹¹	1.4x10 ⁻⁸	1.0x10 ⁻⁴
Deflagration inside a glovebox	4.8x10 ⁻¹¹	4.8x10 ⁻⁸	1.9x10 ⁻¹¹	1.9x10 ⁻⁸	3.0x10 ⁻⁹	3.0x10 ⁻⁶	1.0x10 ⁻⁴
Forklift breach of containment	3.7x10 ⁻¹⁷	8.2x10 ⁻¹⁴	1.5x10 ⁻¹⁷	3.3x10 ⁻¹⁴	2.3x10 ⁻¹⁵	5.1x10 ⁻¹²	4.5x10 ⁻⁵
Nuclear criticality	9.7x10 ⁻¹⁴	9.7x10 ⁻⁸	4.6x10 ⁻¹⁴	4.6x10 ⁻⁸	1.1x10 ⁻¹²	1.1x10 ⁻⁶	1.0x10 ⁻⁷
Beyond evaluation basis fire in a process cell	1.6x10 ⁻¹²	1.6x10 ⁻⁶	6.6x10 ⁻¹³	6.6x10 ⁻⁷	1.0x10 ⁻¹⁰	1.0x10 ⁻⁴	1.0x10 ⁻⁷
Oxyacetylene explosion in a process cell	2.5x10 ⁻⁹	2.5x10 ⁻³	9.7x10 ⁻¹⁰	9.7x10 ⁻⁴	1.5x10 ⁻⁷	0.15	1.0x10 ⁻⁷
Beyond evaluation basis earthquake	1.2x10 ⁻⁹	1.2x10 ⁻³	4.8x10 ⁻¹⁰	4.8x10 ⁻⁴	7.4x10 ⁻⁸	0.074	1.0x10 ⁻⁷
Expected risk ^d	2.0x10 ⁻⁷	—	7.9x10 ⁻⁸	—	1.2x10 ⁻⁵	—	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.9.1-4 and M.5.3.9.1-5 and the MACCS computer code.

Table 4.3.2.9-8. Plutonium Conversion Facility Accident Impacts at Oak Ridge Reservation

Accident Description	Worker at 722 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c	Accident Frequency (per yr)
Fire on the loading dock	5.6x10 ⁻⁷	1.1x10 ⁻⁴	7.0x10 ⁻⁷	1.4x10 ⁻⁴	1.3x10 ⁻⁴	0.026	5.0x10 ⁻⁴
Fire in the process cell	6.8x10 ⁻¹³	6.8x10 ⁻¹⁰	8.4x10 ⁻¹³	8.4x10 ⁻¹⁰	1.6x10 ⁻¹⁰	1.6x10 ⁻⁷	1.0x10 ⁻⁴
Deflagration inside a glovebox	1.4x10 ⁻¹⁰	1.4x10 ⁻⁷	1.8x10 ⁻¹⁰	1.8x10 ⁻⁷	3.3x10 ⁻⁸	3.3x10 ⁻⁵	1.0x10 ⁻⁴
Forklift breach of containment	1.1x10 ⁻¹⁶	2.4x10 ⁻¹³	1.3x10 ⁻¹⁶	3.0x10 ⁻¹³	2.5x10 ⁻¹⁴	5.6x10 ⁻¹¹	4.5x10 ⁻⁵
Nuclear criticality	2.4x10 ⁻¹³	2.4x10 ⁻⁷	3.0x10 ⁻¹³	3.0x10 ⁻⁷	1.8x10 ⁻¹¹	1.8x10 ⁻⁵	1.0x10 ⁻⁷
Beyond evaluation basis fire in a process cell	4.8x10 ⁻¹²	4.8x10 ⁻⁶	6.0x10 ⁻¹²	6.0x10 ⁻⁶	1.1x10 ⁻⁹	1.1x10 ⁻³	1.0x10 ⁻⁷
Oxyacetylene explosion in a process cell	7.9x10 ⁻⁹	7.9x10 ⁻³	9.8x10 ⁻⁹	9.8x10 ⁻³	1.6x10 ⁻⁶	1.6	1.0x10 ⁻⁷
Beyond evaluation basis earthquake	3.5x10 ⁻⁹	3.5x10 ⁻³	4.4x10 ⁻⁹	4.4x10 ⁻³	8.2x10 ⁻⁷	0.82	1.0x10 ⁻⁷
Expected risk ^d	5.8x10 ⁻⁷	—	7.2x10 ⁻⁷	—	1.3x10 ⁻⁴	—	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 772 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [772 m for the facility at ORR], whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.9.1-4 and M.5.3.9.1-5 and the MACCS computer code.

Table 4.3.2.9-9. Plutonium Conversion Facility Accident Impacts at Savannah River Site

	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c	Accident Frequency (per yr)
Accident Description							
Fire on the loading dock	3.2x10 ⁻⁷	6.3x10 ⁻⁵	7.7x10 ⁻⁹	1.5x10 ⁻⁶	3.2x10 ⁻⁵	7.5x10 ⁻³	5.0x10 ⁻⁴
Fire in the process cell	3.8x10 ⁻¹³	3.8x10 ⁻¹⁰	9.3x10 ⁻¹⁵	9.3x10 ⁻¹²	4.5x10 ⁻¹¹	4.5x10 ⁻⁸	1.0x10 ⁻⁴
Deflagration inside a glovebox	7.9x10 ⁻¹¹	7.9x10 ⁻⁸	1.9x10 ⁻¹²	1.9x10 ⁻⁹	9.4x10 ⁻⁹	9.4x10 ⁻⁶	1.0x10 ⁻⁴
Forklift breach of containment	6.0x10 ⁻¹⁷	1.3x10 ⁻¹³	1.5x10 ⁻¹⁸	3.3x10 ⁻¹⁵	7.2x10 ⁻¹⁵	1.6x10 ⁻¹¹	4.5x10 ⁻⁵
Nuclear criticality	1.4x10 ⁻¹³	1.4x10 ⁻⁷	2.8x10 ⁻¹⁵	2.8x10 ⁻⁹	2.3x10 ⁻¹²	2.3x10 ⁻⁶	1.0x10 ⁻⁷
Beyond evaluation basis fire in a process cell	2.7x10 ⁻¹²	2.7x10 ⁻⁶	6.6x10 ⁻¹⁴	6.6x10 ⁻⁸	3.2x10 ⁻¹⁰	3.2x10 ⁻⁴	1.0x10 ⁻⁷
Oxyacetylene explosion in a process cell	4.4x10 ⁻⁹	4.4x10 ⁻³	9.7x10 ⁻¹¹	9.7x10 ⁻⁵	4.7x10 ⁻⁷	0.47	1.0x10 ⁻⁷
Beyond evaluation basis earthquake	2.1x10 ⁻⁹	2.1x10 ⁻³	4.8x10 ⁻¹¹	4.8x10 ⁻⁵	2.3x10 ⁻⁷	0.23	1.0x10 ⁻⁷
Expected risk ^d	3.2x10 ⁻⁷	—	7.9x10 ⁻⁹	—	3.8x10 ⁻⁵	—	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values.

Source: Calculated using the source term in Tables M.5.3.9.1-4 and M.5.3.9.1-5 and the MACCS computer code.

facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive serious or fatal impacts.

| [Text deleted.]

4.3.2.10 Waste Management

This section summarizes the waste management impacts for the construction and operation of a Pu conversion facility. There is no spent nuclear fuel or HLW associated with the operation of the Pu conversion facility. Table 4.3.2.10–1 provides the projected operational waste volumes generated at the sites analyzed as a result of the Pu conversion facility. Facilities that would support the Pu conversion facility would treat and package all generated waste into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated, and depending on the type of waste, disposed of, onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the Pu conversion facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.2.2. A detailed description of the waste management activities that would be required to support the Pu conversion facility can also be found in Section E.3.2.2.

Construction and operation of a Pu conversion facility would impact existing waste management activities at each of the sites analyzed, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, solid nonhazardous, and hazardous wastes. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any is generated, it would be managed in accordance with site practice, and all applicable Federal and State regulations.

Table 4.3.2.10–1. Estimated Annual Generated Waste Volumes for the Plutonium Conversion Facility^a

Category	New Facility (m ³)	Hanford No Action (m ³)	NTS No Action (m ³)	INEL No Action (m ³)	Pantex No Action (m ³)	ORR No Action (m ³)	SRS No Action (m ³)
Transuranic							
Liquid	3.2 ^b	None	None	None	None	None	None
Solid	278	271	None	3.5	None	119	338
Mixed Transuranic							
Liquid	0	None	None	None	None	None	None
Solid	191	98	None	Included in TRU	None	None	Included in TRU
Low-level							
Liquid	56 ^b	None	Dependent on restoration activities	None	8	2,970	74,000
Solid	1,743	3,390	15,000	7,200	32	7,320	16,400
Mixed low-level							
Liquid	0.04	3,760	None	4	4	87,600	1,330
Solid	191	1,505	50	170	46	432	7,700
Hazardous							
Liquid	2	Included in solid	Included in solid	Included in solid	2	6,460	1,260
Solid	11	560	212	1,200	31	26	15,100

Table 4.3.2.10-1. Estimated Annual Generated Waste Volumes for the Plutonium Conversion Facility^a—Continued

Category	New Facility (m ³)	Hanford No Action (m ³)	NTS No Action (m ³)	INEL No Action (m ³)	Pantex No Action (m ³)	ORR No Action (m ³)	SRS No Action (m ³)
Nonhazardous (sanitary)							
Liquid	15,000	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000
Solid	2,060	5,107	2,120	52,000	339	53,100	61,200
Nonhazardous (other)							
Liquid	56	Included in sanitary	Included in sanitary	None	Included in sanitary	650,000	Included in sanitary
Solid	0	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary

^a The No Action volumes are from Tables 4.2.1.10-1, 4.2.2.10-1, 4.2.3.10-1, 4.2.4.10-1, 4.2.5.10-1, and 4.2.6.10-1. Incremental waste generation volumes for Pu conversion are from Table E.3.2.2-1. Waste effluent volumes (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in Table E.3.2.2-1.

^b Liquid TRU and LLW would be treated and solidified prior to disposal.

Following treatment and volume reduction, approximately 278 m³ (364 yd³) of TRU waste consisting of solidified liquid TRU waste (such as decontamination solutions, used HEPA filters, contaminated wipes and rags, and glovebox sweepings), would require treatment and repackaging in a radwaste facility to meet the current planning-basis WIPP WAC or alternative treatment level. Hanford, INEL, and SRS have existing and planned TRU waste facilities that could be utilized. Due to their limited capability to process, package, and store TRU waste, a radwaste facility would need to be constructed as part of the Pu conversion facility if sited at Pantex, ORR, or NTS. An estimated 191 m³ (250 yd³) of mixed TRU waste would also require treatment and packaging to meet the current planning-basis WIPP WAC or alternative treatment level. Mixed TRU waste would principally be leaded rubber gloves. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), 54 truck shipments per year or, if applicable, 27 regular train shipments per year or 9 dedicated train shipments per year, would be required.

The Pu conversion facility conceptual design includes a radioactive liquid waste treatment facility which would treat the 56 m³ (14,800 gal) of liquid LLW from infrequent container decontamination, laboratory solutions, and scrubber solutions from stacks and exhaust systems. After treatment and volume reduction, approximately 1,743 m³ (2,280 yd³) of solid LLW from solidified liquid LLW, packaging materials, HEPA filters, glovebox parts, protective clothing, decontamination materials (swipes, mops), and damaged equipment would require disposal in a DOE LLW disposal facility. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.5 ha/yr (1.3 acres/yr) at Hanford and ORR; 0.3 ha/yr (0.7 acres/yr) at NTS and INEL; and 0.2 ha/yr (0.5 acres/yr) at SRS. With no onsite LLW disposal capability, Pantex would require 105 additional LLW shipments per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

Approximately 0.04 m³ (11 gal) of liquid and 191 m³ (250 yd³) of solid mixed LLW, consisting of solvent rags, Pb, and hydraulic fluids which have been contaminated with radioactive constituents, would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the Tri-Party Agreement for Hanford or the respective site treatment plans that were developed to comply with the *Federal Facility Compliance Act* for the remainder of the sites analyzed.

Liquid hazardous wastes would consist of cleaning solvents, cutting oils, vacuum pump oils, film processing fluids, hydraulic fluids from mechanical equipment, antifreeze solutions, and paint. Liquid hazardous wastes would be treated onsite or collected in DOT-approved containers and shipped offsite to RCRA-permitted treatment and disposal facilities. Solid hazardous wastes would consist of lead packing and wipes contaminated with oils, lubricants, and cleaning solvents. After compaction, solid hazardous wastes would be packaged in DOT-approved containers, treated onsite or offsite and shipped to RCRA-permitted treatment facilities. After treatment the waste would be disposed of offsite in commercial RCRA-permitted disposal facilities. All the sites analyzed would have adequate capacity to stage the 2 m³ (528 gal) of liquid and 11 m³ (15 yd³) of solid hazardous wastes until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

Approximately 15,000 m³ (3,960,000 gal) of liquid nonhazardous sanitary and industrial wastewater, steam plant blowdown, and stormwater runoff would require treatment in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems may be required. Approximately 2,060 m³ (2,700 yd³) of solid nonhazardous wastes such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

4.3.3 DEEP BOREHOLE ALTERNATIVE CATEGORY

These sections describe two deep borehole alternatives for the disposition of Pu: Direct Disposition Alternative and Immobilized Disposition Alternative. Impacts from borehole construction and operations are described on a generic range of site conditions within the United States. Impacts from the immobilization facility on the following representative sites are described: Hanford, NTS, INEL, Pantex, ORR, and SRS. The sections describe the construction and operational impacts of the Deep Borehole Alternative facilities on the following potentially affected areas: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomic, public and occupational health and safety, and waste management. The impacts for either of the alternatives in these sections would be in addition to those associated with the pit disassembly/conversion facility (Section 4.3.1) and the Pu conversion facility (Section 4.3.2). The deep borehole complex is defined for a generic site over a range of characteristics as defined in Section 3.10. [Text deleted.] Should either of the deep borehole alternatives be selected, a siting study would be conducted in support of tiered NEPA documentation.

4.3.3.1 Direct Disposition Alternative

The environmental impacts described in the following sections are based on the analysis of the deep borehole complex for the Direct Disposition Alternative as described in Section 2.4.3.1. Environmental impacts for this facility are described in the context of a generic range of conditions that could exist at potential locations.

4.3.3.1.1 *Land Resources*

The deep borehole complex would disturb 63 ha (156 acres) of land during construction of which 57 ha (141 acres) would be used during operation. The facility would be sited within a 1.6-km (1-mi) buffer zone for a total land requirement of 2,041 ha (5,044 acres). However, the potential site could range up to 20,000 ha (49,420 acres) of land area. If the borehole site were located on privately owned land, it would likely require the low to middle range of land area. If the site were located on publicly owned land (Federal, State, or local), the borehole could be part of a much larger site and could require the upper range of land area. [Text deleted.] Because no site has been identified for analysis, impacts to land use and visual resources cannot be determined at this time. If this alternative is selected, a siting study would be conducted in support of NEPA tiered documentation.

4.3.3.1.2 Site Infrastructure

Since no actual sites for a deep borehole complex have been considered, the site infrastructure impact analysis for constructing, operating, and post-closure monitoring of the new complex compares the requirements shown in the tables in the appendices against the generic deep borehole disposition site described in Section 3.9.2.

Implementation of the alternative for direct emplacement of Pu into a deep borehole requires construction of a stand-alone complex containing five groupings of surface facilities and several very deep boreholes, about 2 to 4 km (1.3 to 2.5 mi) below the surface. Upon completion of the Pu disposition mission, only a concrete cap remains on the surface.

The region's utility and transportation infrastructure must be extended to support the facilities and operations of this proposed borehole complex. Connection of the borehole complex to the nearest existing electrical utility via high-voltage transmission lines may require constructing additional transmission lines and obtaining rights-of-way.

Impacts from construction of the deep borehole complex using standard construction practices for the surface facilities and transportation links are shown in Table 4.3.3.1.2-1. At a minimum, a 1.6-km (1-mi) two-lane paved road and railroad spur track would have to be constructed for the deep borehole complex to transport workers and material and to deliver equipment. The length depends on the specific site selected and distance from existing transportation. Rights-of-way may also be required.

The surface facilities would be metal framed, sealed buildings with a 10- to 20-year usable life, which would be typical for a packaging and handling operation. It is estimated to require approximately 3 years to construct the necessary borehole complex facilities. The greatest surface effects from subsurface borehole construction would be caused by the surface retention areas containing all material removed during drilling operations. The total amount of utilities and material resources consumed during the construction period, assuming only 1.6 km (1 mi) of roads, is shown in Table 4.3.3.1.2-1.

Table 4.3.3.1.2-1. Additional Site Infrastructure Needed for the Construction of the Deep Borehole Complex—Direct Disposition Alternative (Annual)

Resource	Construction Requirement	Range of Resource Availability at the Generic Borehole Site
Electrical	600 MWh	6,500 to 12,000 MWh
Oil	2,133,000 l	0 to 100 million
Natural gas	0	0 to 5 million m ³
Coal	0	0 to 200,000 t

Source: LLNL 1996a.

Since the lower end of the range of resources available generally exceeds the annualized construction requirement, there would be minimal impact on these resources during construction.

Borehole facility operations require electrical power, compressed air, process water, and process wastewater treatment. The impacts to site infrastructure from these emplacement operations are shown in Table 4.3.3.1.2-2. The range of available resources at the generic borehole site was previously described in Section 3.9.2. The 6,500 MWh electrical requirement to operate the entire borehole array area for a year would have no measurable impact on any of the sub-regional power pools in the contiguous 48 states. Fuel and transportation requirements present no measurable impacts. Since oil and natural gas availability is governed by usage, any additional oil and natural gas could be procured.

Table 4.3.3.1.2–2. Additional Site Infrastructure Needed for the Operation of the Deep Borehole Complex—Direct Disposition Alternative (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/ yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	1.6	1.6	6,500	2	774,400	5,100,000	0
Range of available resources	0 to 60	0 to 20	6,500 to 12,000	2 to 1,000	0 to 100 million	0 to 5 million	0 to 200,000
Amount required in excess of low-end site availability	1.6	1.6	0	0	774,100	5,100,000	0

Source: LLNL 1996a.

During the post-closure period, the borehole array area of 25 ha (60 acres) would be declared a limited access area indefinitely, and a 1.6-km (1-mi) buffer zone of 1,358 ha (3,355 acres) may also be declared off limits. The disturbed area remaining after decommissioning would be the 15 m x 15 m (50 ft x 50 ft) concrete security and water anti-infiltration caps installed above the borehole array, assumed to be four holes. Even though the borehole area would be designated as limited access, there are minimal continuing requirements or effects above ground. These minimal requirements include surveillance and groundwater monitoring. Surveillance could be accomplished from a remote location without impact at the site. Groundwater monitoring could be done from locations at various distances from the site. There would be a continuing infrastructure impact directly at the site in that any future land use requiring excavation or mining operations would be restricted in perpetuity due to the long half-life of Pu. Such restrictions could be institutionalized by constructing drilling barriers and installing a variety of permanent markers.

4.3.3.1.3 Air Quality and Noise

Construction and operation of the deep borehole complex would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from operation of this facility have been compared with Federal standards. Impacts for radiological airborne emissions are discussed in Section 4.3.3.1.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at the generic site. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM₁₀ and TSP concentrations are expected to increase during the peak construction period, especially during dry and windy conditions. Appropriate control measures would be followed. It is expected that the site will continue to comply with applicable Federal and State ambient air quality standards during construction.

Emission rates for operation of the deep borehole complex are presented in Table F.1.3–7. Air pollutant emissions sources associated with operations include the following:

- Operation of boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators

| [Text deleted.]

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for facility operation plus the No Action concentration are presented in Table 4.3.3.1.3–1.

NOISE

The location of the facilities associated with the deep borehole complex relative to the site boundary and sensitive receptors was examined to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Table 4.3.3.1.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Deep Borehole Complex and No Action Alternative—Direct Disposition Alternative

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ^a ($\mu\text{g}/\text{m}^3$)	Generic Site ^b ($\mu\text{g}/\text{m}^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000	72.38
	1-hour	40,000	103.40
Lead	Calendar Quarter	1.5	^c
Nitrogen dioxide	Annual	100	28.37
Ozone	1-hour	235	^d
Particulate matter less than or equal to 10 microns in diameter	Annual	50	10.84
Sulfur dioxide	24-hour	150	43.38
	Annual	80	2.59
	24-hour	365	10.36
	3-hour	1,300	23.32
Hazardous and Other Toxic Compounds^e			
[Text deleted.]			

^a The Federal standards are presented.

^b The concentration represents the alternative contribution only. No Action concentrations at a generic site cannot be determined since there is a range of possible pollutants and conditions that could be found at a potential site.

^c No sources of this pollutant have been identified.

^d Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

^e Emissions of unspecified hydrocarbons were not modeled.

Note: Concentrations are based on site contribution and do not include the contribution from non-facility sources.

Source: 40 CFR 50; LLNL 1996a.

Non-traffic noise sources associated with operation of these facilities include: ventilation systems, cooling systems, material handling equipment, drilling rigs, pumps, and generators. These noise sources are assumed to be located at sufficient distance from offsite areas so that the contribution to offsite noise levels would continue to be small. It is assumed that, due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.3.1.4 Water Resources

Water resources would be affected by the operation of a direct emplacement deep borehole complex. Water resource requirements and discharges provided in Tables C.1.1.3–1 and C.2.1.3–1 and Table E.3.3.1–1 were used to assess impacts to surface and groundwater. Table 4.3.3.1.4–1 provides the total water requirements and estimated construction and operation wastewater effluent volumes projected to be generated as a result of the deep borehole complex. If this alternative is selected, a siting study would be considered and met in future site specific tiered NEPA documents, as appropriate. During construction and operation, either surface water, groundwater, or a municipal source could be used to support the facility. Support facilities for the deep borehole complex would treat and dispose of wastewater in accordance with regulatory requirements.

Surface Water. Surface water could be used to supply the fresh water required for the deep borehole facility. Water quantities required for both construction and operation of the generic deep borehole facility are shown in Table 4.3.3.1.4–1. The facility would be located such that these quantities of surface water would be readily available.

**Table 4.3.3.1.4–1. Potential Changes to Water Resources Resulting From the Deep Borehole Complex—
Direct Disposition Alternative**

Affected Resource Indicator	Generic Site
Water Source	Surface or Ground
Construction	
<i>Water Availability and Use</i>	
Total water requirement (million l/yr)	15.1
<i>Water Quality</i>	
Total wastewater discharge (million l/yr)	12.0
Operation	
<i>Water Availability and Use</i>	
Total water requirement (million l/yr)	165.4
<i>Water Quality</i>	
Total wastewater discharge (million l/yr)	17.4
Floodplain	
Is action in 100-year floodplain?	No
Is critical action in 500-year floodplain?	No

Source: LLNL 1996a.

Surface water quality could be affected by the discharge of treated industrial and sanitary wastewater to surface impoundments (that is, evaporation/infiltration ponds), dry lake beds, or natural drainage channels. NPDES permits would be obtained prior to any such discharge. These permits would specify the allowable limits for any potential pollutants and would establish strict effluent monitoring requirements.

Drilling operations also include activities that have the potential to affect surface water quality. The primary effluents from drilling are the overflow of briny water from the mud pits and the briny water that would be pumped out of the well from conductive features in the rock. Water and drilling muds are circulated through the borehole during drilling. Drilling mud, which includes chemicals such as polymers, soaps, and pH control additives, and rock cuttings removed from the borehole are staged in surface impoundments called mud pits. The rock cuttings settle by gravity and the mud is recirculated to the borehole. These pits could be lined to prevent infiltration to the subsurface. Depending on State and local regulations, the rock cuttings may be left in place in the mud pit and covered following completion of the drilling process. Because the drilling mud and chemical additives would be selected for compatibility with the specific downhole conditions, the exact

composition of the drilling mud and specific chemical additives would not be known until the site-specific geology was determined.

No wastewater would be generated by the emplacement and borehole sealing process. Water produced from the borehole, however, would be sampled for radioactivity and brine chemical composition. The sample would first be tested for radioactivity (from the fissile material) and, if not contaminated, the water would be returned to the mud pits. If the water is contaminated, it would be routed to the process wastewater treatment facility. Other wastewater originating from the borehole array area would be expected to consist of mopwaters and cleaning solutions, sealants and additives, drilling mud and grout additives, and machine coolant wastes.

The process wastewater treatment facility would be equipped to treat conventional, hazardous, radioactive, and mixed liquid wastes generated at several facilities onsite (for example, the surface processing and fissile material-grout preparation facilities). Treatment processes for each type of waste stream would be segregated. Effluent from this facility would be reclaimed after treatment and used as makeup water to the cooling tower; there would be no surface discharge.

Utility operations would also generate wastewater. This wastewater would consist of cooling tower blowdown and boiler blowdown and would be treated in the utility wastewater treatment facility. Treatment would consist of reverse osmosis followed by evaporation and spray drying. Reclaimed water produced by this facility would be used as makeup water for the cooling tower; there would be no surface discharge.

Another potential source of impacts to surface water quality is stormwater runoff from graded areas, raw material and drilling waste storage areas, and paved areas. This water would be retained in catch tanks or ponds, tested for the appropriate parameters, and then discharged to an infiltration pond if it passed the testing requirements. If the water exceeded any established thresholds, it would be diverted to an evaporation basin where any distillate would be treated and used as reclaimed water. NPDES permits, which would specify the exact testing requirements, would be required for each type of discharge (for example, point source and stormwater).

Groundwater. If water required for construction and operation were obtained from groundwater resources, it likely would be supplied from groundwater from the near-surface aquifer. Groundwater quantities required for both construction and operation of the generic deep borehole facility are shown in Table 4.3.3.1.4–1.

Several factors contribute to the theory that the deep borehole can isolate the fissile material for the required timeframe (many tens of thousands of years): the very slow movement of “groundwater” (brine) at great depths; the very slow release of radionuclides from the disposal form (molecular diffusion); the retardation or adsorption of released radionuclides by physiochemical interactions with the host rock; and the capability to perform the drilling, emplacing, and borehole-sealing operations without compromising the natural barriers of the earth’s crust (host rock) or creating new pathways to the biosphere (that is, accessible environment) (LLNL 1996a:1-2,1-5).

In order for this alternative to be feasible, several site-specific environmental features are preferred: competent, seismically stable host rock with low fracture density and no fault zones; brines with high salinity (indicative of long-term isolation from the biosphere), low carbonate concentrations, and slightly basic and reducing geochemistry; low thermal gradient; and a high salinity gradient. Thermal and salinity gradients are key factors in the potential for brine circulation (advective transport) within the borehole. This is the principle mechanism for potential radionuclide migration in the deep borehole environment. Radionuclides will also migrate extremely slowly in the deep subsurface via molecular diffusion. Site specific siting criteria would be met in future tiered NEPA documents, as appropriate.

Casing the borehole (in the upper portion before competent bedrock is encountered) and sealing or cementing around the casing would be a primary barrier to fluid flow. The cement would seal the void space between the

casing and the borehole wall, thus eliminating this potential pathway for convective fluid circulation and possible mobilization of fissile material to the biosphere. In addition, the casing and cement grout would prevent groundwater from near-surface aquifers in the upper portion of the borehole from entering the borehole. This effectively isolates the potable, near-surface groundwater from the drilling muds in the borehole during drilling and also from the waste in the emplacement zone. Similarly, at greater depths, the grout would prevent brines from entering the borehole during drilling. The grout would also seal fractures in the host rock that intersect the borehole, which would otherwise represent potential flow pathways. In addition, to further isolate the fissile material, specially formulated sealing plugs would be installed across the entire borehole cross-section at strategic locations within the borehole.

Other engineered safety features at the ground surface would be provided to ensure that the disposal system would operate in compliance with regulatory requirements. For instance, wastewater discharge holding ponds could be lined and used as evaporation ponds instead of infiltration ponds. Additionally, near-surface groundwater would be periodically sampled and analyzed for radioactivity (and nonradioactive contaminants) emanating from the surface facilities and from the emplaced waste. The groundwater monitoring wells would be located both onsite and at strategically placed distant, downgradient points. All of the design criteria would be evaluated in future site-specific tiered NEPA documentation, as appropriate, should the Direct Disposition Alternative be selected.

4.3.3.1.5 *Geology and Soils*

| Construction of a deep borehole complex would require the disturbance of approximately 63 ha (156 acres). The deep borehole complex represents an irreversible commitment because wastes in below-ground area could not be completely removed, nor could the site be feasibly used for any other purposes following closure of the facility. This land would be perpetually unusable because of the substrata and would not be suitable for potentially intrusive facilities such as mining, utilities, or building foundations. Because no site has been identified for analysis, impacts to geologic and soil resources cannot be determined at this time.

| The identification and acceptance of a site location would require extensive site characterization to ensure that the primary objective of the deep borehole complex, isolation from the biosphere, would be met. A siting study would be conducted in support of the tiered NEPA documentation.

4.3.3.1.6 *Biological Resources*

Construction of a deep borehole complex would disturb 63 ha (156 acre) of land at an unspecified location. Additional land would be needed for rights-of-way. If this alternative is selected, a siting study would be conducted in support of tiered NEPA documentation. During the siting process, concern for individual species (and critical habitats) that are sensitive to disturbance and whose existence may be threatened by development would be a primary consideration. Further, once a site is selected, consultation with USFWS and the appropriate state agency would take place to ensure that threatened and endangered species would be protected. Potential impacts to individual species, necessary consultation, and protection measures will be addressed in site-specific NEPA documentation.

Terrestrial Resources. The excavation of material from a deep borehole could lead to potential impacts to terrestrial resources. Dust from drilling operations and the stockpiling of spoils could be deposited on plant surfaces and interfere with normal photosynthesis. Runoff from spoils disposal areas could affect vegetation in nearby areas.

Construction of the facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the deep borehole complex. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Clearing and grading operations could result in the direct loss of wetlands, although proper placement of the facility within the overall site would eliminate or reduce the potential for such loss. Where direct loss is unavoidable, mitigation measures would be developed. [Text deleted.] In general, direct impacts to wetlands from construction and operations would not be expected at dry sites.

Indirect impacts to wetlands from a deep borehole complex could occur as a result of stormwater runoff carrying sediments to wetlands located adjacent to the site. Changes in hydrology, water quality, and soils could occur as a result of alterations in water levels, runoff, and the buildup of sediments. These changes could, in turn, change the vegetative composition of the wetland.

Aquatic Resources. During construction of a deep borehole complex, potential impacts to aquatic resources could result from stormwater runoff, including runoff from spoils disposal areas. Runoff could alter flow rates, increase turbidity, and lead to sedimentation of stream beds. These impacts could, in turn, cause temporary and permanent changes in species compositions and density, and alter breeding habitats. Operational impacts to aquatic resources would generally be expected to be minimal since wastewater volumes would be minimal and would be discharged through an NPDES permitted outfall. However, runoff from spoils disposal areas could impact aquatic resources during operation. In general, direct impacts to aquatic resources from construction and operations would not be expected at dry sites.

Threatened and Endangered Species. Construction and operation of the deep borehole complex would have the potential to impact threatened and endangered species. Sources of impacts would be similar to those

discussed above for terrestrial resources, wetlands, and aquatic resources. The primary difference is that the resources of concern involve individual species (and critical habitats) that are sensitive to disturbance and whose existence may be threatened by development. Consultations with USFWS and State agencies would be conducted at the site-specific level, as appropriate.

4.3.3.1.7 Cultural and Paleontological Resources

The construction of the deep borehole site complex would disturb approximately 63 ha (156 acres) of land. The operational land requirement is 2,041 ha (5,044 acres), which includes a 1.6-km (1-mi) buffer zone. The actual facility requires 57 ha (141 acres) during operation. In addition, approximately 1.6 km (1 mi) each of road or railway would also be constructed. No specific site has been proposed for this alternative. Impacts to cultural and paleontological resources would be addressed in tiered NEPA documents as appropriate. A siting study would be conducted in support of tiered NEPA documentation.

Prehistoric and historic resources that may be NRHP eligible would be identified through additional surveys. Specific concerns about the presence, type, and location of Native American resources would be addressed through consultation with the potentially affected tribes in accordance with NHPA, the *Native American Graves Protection and Repatriation Act*, and the *American Indian Religious Freedom Act*. Therefore, it is not possible to determine potential effects on cultural and paleontological resources.

4.3.3.1.8 Socioeconomics

Candidate sites for the deep borehole complex have not been identified; therefore, the socioeconomic characteristics of the associated REAs and ROIs cannot be fully described. Instead, the following section describes a range of impacts that could potentially result from locating the facility in different types of geographical areas. Although the borehole complex would likely be located in an area away from population centers, the workforce needed to support the construction and operation of the facility would either have to reside in communities within commuting distance, or a small community would develop near the site. Once a specific site is selected, a more detailed analysis will be performed in tiered NEPA documents.

Regional Economy Characteristics. Constructing a deep borehole facility would require 870 workers at peak construction and 342 workers each year for 10 years of operation. The number of indirect jobs created by construction and operation of the borehole facility would depend upon the economic structure of the REA where the facility is located.

In a rural REA consisting of small communities, construction of the borehole facility could create as many as 400 indirect jobs. The number of indirect jobs created from operation could range from 0 to 350 depending on the types and concentration of businesses that are located in the region. If the borehole facility were constructed in an REA that included a large metropolitan area, up to 1,300 indirect jobs could be generated during construction, and up to 650 indirect jobs could be created during operation.

No matter where the borehole facility is located, the affected region's per capita income would increase and its unemployment rate would decrease. The magnitude of economic benefit to the REA would depend on the state of the regional economy and the availability of resident labor at the time of construction, as well as the capacity of the region's infrastructure (for example, transportation network) to accommodate increased business activity.

At the end of the 10-year operating period, the workforce would be phased out, and, in the absence of alternative job opportunities, regional unemployment would increase and per capita income would decrease. Phaseout in a diversified economy would lead to minimal losses; however, the more rural the REA the more unlikely it is there would be new employment opportunities to offset the loss of jobs.

The socioeconomic effects of a borehole facility on an REA would be maximized if the facility were located in a region with little or no previous economic activity. The effect would be similar to that of a mining town undergoing a boom-bust cycle. In other words, a community would develop, there would be an influx of workers and their families, and after the project was completed, there would be mass out-migration from the community.

Population and Housing. Most REAs would probably have sufficient available labor to construct the borehole facility, and few or no new workers would in-migrate to the ROI. Many construction workers would likely commute long distances rather than relocate near the site. However, some temporary housing may be needed near the site to accommodate a portion of the workforce who are not willing to endure a long commute during the construction period.

If the available labor force in REA would be sufficient to operate the facility, little or no in-migration would occur. However, labor availability would decrease the more rural the REA, thus increasing in-migration to the region. In any case, housing to accommodate in-migrating workers and their families would depend upon the ROI's owner/renter vacancy rates and housing market trends.

Following completion of the 10-year operation period, there would likely be out-migration of population because of the reduced job opportunities. Such out-migration would increase housing vacancies and could affect housing market values.

Community Services. There could be an increase in demand for community services during the construction phase of the project, depending on the need for in-migrating construction workers. The demand for these services would most likely increase further during operation. The ability to meet these new demands would depend on the level and capacities of services in the ROI where the borehole facility would be located. A more rural ROI would likely be the most affected.

Once the 10-year operation of the borehole facility is completed, there could be some out-migration. Any out-migration would reduce the demand on community services.

Local Transportation. Traffic levels in the vicinity of the borehole facility would increase by 1,670 vehicle trips per day during the construction phase and 657 during the operation phase. It is possible that the borehole facility would be located in a remote area, requiring improvement or construction of some roads to enable workers to access the site (Socio 1996a).

4.3.3.1.9 Public and Occupational Health and Safety

This section describes the radiological and hazardous chemical releases and the associated impacts resulting from either normal operation or accidents involved with the direct emplacement of the Pu in a deep borehole. The section first describes the impacts from normal operation at the generic site, followed by a description of impacts from postulated facility accidents.

For the public, the analysis includes an annual dose and cumulative risk to the maximally exposed individual, population, and average individual within 80 km (50 mi). For workers, the analysis includes an annual and cumulative risk to an average involved and noninvolved worker and total involved and noninvolved workers. The radiological health effects were derived from data for representative DOE sites described in Sections 3.2 through 3.8. Data for the representative DOE sites were used to allow quantification of impacts, but do not necessarily capture the entire range of potential deep borehole complex sites. This approach to the radiological risk assessment differs from the analysis of other resources, which are analyzed based on a generic deep borehole site. Because the analysis of radiological dose impacts requires site-specific conditions, such as meteorology and surrounding populations, a generic site analysis would not be possible because of the infinite number of site-specific conditions.

Summaries of the radiological impacts to the public and to workers associated with normal operation during the assumed 10-year campaign time are presented in Tables 4.3.3.1.9-1 and 4.3.3.1.9-2, respectively. [Text deleted.] Impacts from hazardous chemicals to these same groups are given in Table 4.3.3.1.9-3. Summaries of impacts associated with postulated accidents are given in Table 4.3.3.1.9-4. Detailed results are presented in Section M.

Normal Operation. There would be no radiological releases associated with the construction of the deep borehole complex. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment as well as direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the deep borehole complex are presented in Table 4.3.3.1.9-1. The impacts from all site operations, including the new borehole complex, are also given. Comparisons of operational doses with natural background radiation doses are included in the table.

The dose to the maximally exposed member of the public due to annual operation of the borehole complex would range from 2.7×10^{-9} to 9.4×10^{-8} mrem. From 10 years of operation, the risk of fatal cancer to this individual would range from 1.4×10^{-14} to 4.7×10^{-13} . The impacts to the average individual would be less. As a result of annual operations, the population dose would range from 5.3×10^{-9} to 1.8×10^{-6} person-rem/yr. The number of fatal cancers in the population due to 10 years of operation would range from 2.7×10^{-11} to 9.0×10^{-9} .

The upper bounding dose of 3.2 mrem to the maximally exposed member of the public due to annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. The risk of fatal cancer to this individual from 10 years of operation would be 1.6×10^{-5} . The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operations, the upper bounding population dose would be within the limit in proposed 10 CFR 834 and would be 44 person-rem. The number of fatal cancers in this population due to 10 years of operation would be 0.22.

Table 4.3.3.1.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Deep Borehole Complex—Direct Disposition Alternative

Receptor	Generic Site ^a	
	Borehole Complex	Total Site ^b
Annual Dose to the Maximally Exposed Individual Member of the Public^c		
Atmospheric release pathway (mrem)	2.7x10 ⁻⁹ to 9.4x10 ⁻⁸	6.1x10 ⁻⁵ to 1.5
Drinking water pathway (mrem)	0	0 to 0.10
Total liquid release pathway (mrem)	0	0 to 1.7
Atmospheric and liquid release pathways combined (mrem)	2.7x10 ⁻⁹ to 9.4x10 ⁻⁸	6.1x10 ⁻⁵ to 3.2
Percent of natural background ^d	8.6x10 ⁻¹⁰ to 3.2x10 ⁻⁸	1.8x10 ⁻⁵ to 1.1
10-year fatal cancer risk	1.4x10 ⁻¹⁴ to 4.7x10 ⁻¹³	3.1x10 ⁻¹⁰ to 1.6x10 ⁻⁵
Annual Population Dose Within 80 Kilometers^e		
Atmospheric release pathways (person-rem)	5.3x10 ⁻⁹ to 1.8x10 ⁻⁶	2.8x10 ⁻⁴ to 40
Total liquid release pathways (person-rem)	0	0 to 4.7
Atmospheric and liquid release pathways combined (person-rem)	5.3x10 ⁻⁹ to 1.8x10 ⁻⁶	2.8x10 ⁻⁴ to 44
Percent of natural background ^d	5.7x10 ⁻¹¹ to 4.7x10 ⁻¹⁰	2.4x10 ⁻⁷ to 0.017
10-year fatal cancers	2.7x10 ⁻¹¹ to 9.0x10 ⁻⁹	1.4x10 ⁻⁶ to 0.22
Annual Dose to the Average Individual Within 80 Kilometers^f		
Atmospheric and liquid release pathways combined (mrem)	1.8x10 ⁻¹⁰ to 1.4x10 ⁻⁹	8.0x10 ⁻⁷ to 0.049
10-year fatal cancer risk	9.0x10 ⁻¹⁶ to 7.0x10 ⁻¹⁵	4.0x10 ⁻¹² to 2.5x10 ⁻⁷

^a Ranges for the “Borehole Complex” and “Total Site” doses may not necessarily reflect the same respective sites.

^b Includes impacts from No Action baseline facilities (refer to Sections 4.2.1.9 through 4.2.6.9) if the borehole were located on a DOE site, shown for comparison purposes only, and would not apply if a generic non-DOE site were selected for the borehole complex.

^c The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR 61, Subpart H) under the CAA, 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

^d The annual natural background radiation level: the average individual receives a dose that could range from 295 to 338 mrem; the population within 80 km receives a dose that could range from 9,190 to 379,000 person-rem.

^e For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

^f Obtained by dividing the population dose at a site by the number of people projected to be living within 80 km of that site. The number of people ranges from 29,400 to 1,285,000.

Source: Section M.2.

Doses to onsite workers due to normal operations are given in Table 4.3.3.1.9–2. Included are involved workers directly associated with the deep borehole complex, workers who are not involved with the deep borehole complex, and the entire workforce at the site. All doses fall within regulatory limits.

The annual dose to the average borehole complex worker would be 13 mrem; the entire borehole complex workforce would receive 2.7 person-rem annually. The annual dose to the noninvolved worker would range from 2.6 to 32 mrem depending on the borehole site (if an existing DOE site were chosen), and the annual total dose to all noninvolved workers would range from 3.0 to 250 person-rem. The annual dose to the total site workforce would range from 5.7 to 253 person-rem. The risks and numbers of fatal cancers among the different workers due to 10 years of operation are included in Table 4.3.3.1.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Table 4.3.3.1.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Deep Borehole Complex—Direct Disposition Alternative

Receptor	Generic Site
Involved Workforce^a	
Average worker dose (mrem/yr) ^b	13
10-year risk of fatal cancer	5.2×10^{-5}
Total dose (person-rem/yr)	2.7
10-year fatal cancers	0.011
Noninvolved Workforce^c	
Average worker dose (mrem/yr) ^b	2.6 to 32
10-year risk of fatal cancer	1.0×10^{-5} to 1.3×10^{-4}
Total dose (person-rem/yr)	3.0 to 250
10-year fatal cancers	0.012 to 1.0
Total Site Workforce^d	
Dose (person-rem/yr)	5.7 to 253
10-year fatal cancers	0.023 to 1.0

^a The involved worker is a worker associated with operations of the proposed action. The estimated number of badged in-plant workers is 205.

^b The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem/yr (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

^c The noninvolved worker is an onsite worker not associated with operations of the proposed operations of the borehole complex. The ranges for noninvolved workers are based on No Action values for Hanford, NTS, INEL, Pantex, ORR, and SRS. Noninvolved worker doses are shown for comparison purposes and would not apply if the borehole were located at a separate dedicated site. The noninvolved workforce is equivalent to the No Action workforce.

^d The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: LLNL 1996a for involved workers. For the noninvolved workers the ranges are based on the No Action values for Hanford, NTS, INEL, Pantex, ORR, and SRS given in Sections 4.2.1.9, 4.2.2.9, 4.2.3.9, 4.2.4.9, 4.2.5.9, and 4.2.6.9, respectively.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public due to normal operation of the deep borehole facility at the generic site are presented in Table 4.3.3.1.9–3. Included are the impacts due only to operation of the deep borehole facility and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI is 1.2×10^{-3} at the borehole complex generic site. The cancer risk from hazardous chemicals to the MEI is zero (because no carcinogens are released from hazardous chemicals) at the borehole complex generic site. The HI to the onsite worker is 0.29 at the borehole complex generic site, and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals).

Facility Accidents. A set of potential accidents for a deep borehole complex for which there may be a release of radioactivity that could impact onsite workers and the offsite population has been postulated. Accident scenarios considered are Pu storage container breakage during storage; Pu storage container breakage during handling; nuclear criticality during emplacement canister filling; criticality during Pu storage container spill; fire in process area; canister string dropped during emplacement and ruptured in emplacement zone; canister string dropped during emplacement and stuck in isolation zone; Pu container criticality during storage; emplacement canister nuclear criticality in storage; and nuclear criticality of canister contents at bottom of emplacement zone upon rupture of dropped canister string. The range of consequences and risks for a set of accidents at the generic site is presented in Table 4.3.3.1.9–4. The estimated range of environmental data (wet-to-dry site) and the general public population density data (low-to-high density) for the generic site envelopes the site characteristics expected for the direct emplacement site.

Table 4.3.3.1.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Deep Borehole Complex—Direct Disposition Alternative

Receptor	Facility ^a	Total Site ^b
Maximally Exposed Individual (Public)		
Hazard Index ^c	1.2x10 ⁻³	1.2x10 ⁻³
Cancer Risk ^d	0	0
Worker Onsite		
Hazard Index ^e	0.29	0.29
Cancer Risk ^f	0	0

^a Facility=Contribution from the proposed new facility operation only.

^b Total=Includes the contributions from the No Action and the proposed new facility operation.

^c Hazard Index for MEI=Sum of individual Hazard Quotients (noncancer health effects) for the maximally exposed individual.

^d Cancer Risk for MEI=(Emissions concentrations) x (0.286 [converts concentrations to doses]) x (slope factor [SF]). [Text deleted.]

^e Hazard Index for Workers=Sum of individual Hazard Quotients (noncancer health effects) for workers.

^f Cancer Risk for Workers=(Emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (SF). [Text deleted.]

Note: Where there are no known carcinogens among the hazardous chemicals emitted, there are no slope factors; therefore, the calculated cancer risk value is 0.

Source: Section M.3, Table M.3.4–40.

[Text deleted.] The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Before construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Table 4.3.3.1.9-4. Range of Accident Impacts for a Set of Accidents for the Deep Borehole Complex—Direct Disposition Alternative

Accident Scenario	Worker at 1,000 m				Maximum Offsite Individual				Population to 80 km			
	Risk of Cancer Fatality ^a		Probability of Cancer Fatality ^b		Risk of Cancer Fatality ^a		Probability of Cancer Fatality ^b		Risk of Cancer Fatality ^a		Probability of Cancer Fatality ^b	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
Pu storage container breakage during storage	5.1×10^{-16}	2.1×10^{-16}	5.1×10^{-14}	2.1×10^{-14}	1.0×10^{-16}	4.7×10^{-16}	1.0×10^{-14}	4.7×10^{-16}	8.4×10^{-14}	8.4×10^{-16}	9.0×10^{-12}	8.4×10^{-14}
Pu storage container breakage during handling	5.1×10^{-14}	2.1×10^{-14}	5.1×10^{-12}	2.1×10^{-12}	1.0×10^{-14}	4.7×10^{-14}	1.0×10^{-12}	4.7×10^{-14}	8.4×10^{-12}	8.4×10^{-14}	9.0×10^{-10}	8.4×10^{-12}
Nuclear criticality during emplacement canister filling	1.4×10^{-9}	6.2×10^{-10}	1.4×10^{-5}	6.2×10^{-6}	2.9×10^{-10}	1.0×10^{-11}	2.9×10^{-6}	1.0×10^{-7}	6.3×10^{-8}	2.3×10^{-9}	6.3×10^{-4}	2.3×10^{-5}
Nuclear criticality during Pu storage canister spill	1.4×10^{-9}	6.2×10^{-10}	1.4×10^{-5}	6.2×10^{-6}	2.9×10^{-10}	1.0×10^{-11}	2.9×10^{-6}	1.0×10^{-7}	6.0×10^{-8}	3.3×10^{-10}	6.0×10^{-4}	3.3×10^{-6}
Fire in process area	4.6×10^{-13}	1.9×10^{-13}	4.6×10^{-9}	1.9×10^{-9}	9.3×10^{-14}	4.2×10^{-15}	9.3×10^{-10}	4.2×10^{-11}	8.1×10^{-11}	3.3×10^{-10}	8.1×10^{-7}	3.3×10^{-6}
Canister string dropped during emplacement, ruptured in emplacement zone	4.6×10^{-12}	1.9×10^{-12}	4.6×10^{-8}	1.9×10^{-8}	9.3×10^{-13}	4.2×10^{-14}	9.3×10^{-9}	4.2×10^{-10}	8.1×10^{-10}	7.6×10^{-12}	8.1×10^{-6}	7.6×10^{-8}
Canister string dropped during emplacement, ruptured in isolation zone	2.8×10^{-15}	1.1×10^{-15}	2.8×10^{-11}	1.1×10^{-11}	5.6×10^{-16}	2.5×10^{-17}	5.6×10^{-12}	2.5×10^{-13}	4.9×10^{-13}	4.5×10^{-15}	4.9×10^{-9}	4.5×10^{-11}
Pu container nuclear criticality in storage	1.4×10^{-10}	6.2×10^{-11}	1.4×10^{-5}	6.2×10^{-6}	2.9×10^{-11}	1.0×10^{-12}	2.9×10^{-6}	1.0×10^{-7}	6.3×10^{-9}	3.3×10^{-11}	6.3×10^{-4}	3.3×10^{-6}
Emplacement canister nuclear criticality in storage	1.4×10^{-10}	6.2×10^{-11}	1.4×10^{-5}	6.2×10^{-6}	2.9×10^{-11}	1.0×10^{-12}	2.9×10^{-6}	1.0×10^{-7}	6.3×10^{-9}	3.3×10^{-11}	6.3×10^{-4}	3.3×10^{-6}
Nuclear criticality of canister contents at bottom of emplacement zone upon rupture of dropped canister string	1.4×10^{-10}	6.2×10^{-11}	1.4×10^{-5}	6.2×10^{-6}	2.9×10^{-11}	1.0×10^{-12}	2.9×10^{-6}	1.0×10^{-7}	6.3×10^{-9}	3.3×10^{-11}	6.3×10^{-4}	3.3×10^{-6}
Expected risk ^d	3.2×10^{-9}	1.4×10^{-9}	—	—	6.7×10^{-10}	2.3×10^{-11}	—	—	1.4×10^{-7}	3.1×10^{-9}	—	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual or the number of cancer fatalities [for the population to 80 km]) by the accident frequency and the number of years of operations.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks under the lifetime of the facility.

Note: The impacts shown are the maximum for the reference sites. All values are mean values.

Source: Section M.5.

4.3.3.1.10 Waste Management

This section summarizes the waste management impacts for the construction and operation of a deep borehole complex for the Direct Disposition Alternative. There is no spent nuclear fuel or HLW associated with the operation of the deep borehole disposal facility. Table 4.3.3.1.10-1 provides the estimated operational waste volumes projected to be generated as a result of the deep borehole complex for direct disposal. Facilities that would support the deep borehole complex would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, waste could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purpose of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. For purposes of analysis, a pristine site with no waste management infrastructure was assumed for No Action because the deep borehole disposal facility was assumed to be a rural setting where no waste is currently being generated. The incremental waste volumes generated from the deep borehole complex and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.1. A detailed description of the waste management activities that would be required to support the deep borehole disposal facility for direct disposal can also be found in Section E.3.3.1.

Table 4.3.3.1.10-1. Estimated Annual Generated Waste Volumes for the Deep Borehole Complex—Direct Disposition Alternative^a

Category	New Facility (m ³)	No Action (m ³)
Transuranic		
Liquid	0.2 ^b	None
Solid	0.2	None
Mixed Transuranic		
Liquid	0	None
Solid	0.04	None
Low-Level		
Liquid	2 ^b	None
Solid	5	None
Mixed Low-Level		
Liquid	0	None
Solid	0	None
Hazardous		
Liquid	110	None
Solid	17	None
Nonhazardous (Sanitary)		
Liquid	10,600	None
Solid	306	None
Nonhazardous (Other)		
Liquid	6,800	None
Solid	1,250 ^c	None

^a No waste generation was assumed for No Action. Waste generation volumes for deep borehole disposal facility for direct disposal are from Table E.3.3.1-1. Waste effluent volumes (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in Table E.3.3.1-1.

^b Liquid TRU and LLW would be treated and solidified prior to disposal.

^c Includes rock cuttings, bentonite, and polymers from drilling and emplacing borehole sealing facilities.

Construction and operation of a deep borehole complex for direct disposal would require the construction of waste management facilities to treat and store generated TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, solid nonhazardous, and hazardous wastes. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any is generated it would be managed in accordance with all applicable Federal and State regulations.

Less than 1 m^3 (40 gal) of liquid TRU waste generated per year from equipment decontamination would be treated in a waste handling facility to form grout. In the solids treatment area of the waste handling facility less than 1 m^3 ($<1 \text{ yd}^3$) of solid TRU waste from process and facility operations, equipment decontamination, failed equipment, and used tools would be compacted as appropriate, then packaged, assayed, and certified to the current planning-basis WIPP WAC or alternative treatment level. A small quantity ($<0.1 \text{ m}^3$ [$<0.1 \text{ yd}^3$]) of solid mixed TRU waste would require treatment and packaging to meet the current planning-basis WIPP WAC. Mixed TRU waste would be principally rubber gloves and leaded box gloves. To transport the TRU and mixed TRU wastes to WIPP (depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste), one truck shipment every 45 years would be required.

Approximately 2 m^3 (600 gal) of liquid LLW from process wash liquids and excess water from the borehole would be solidified in the waste handling facility. The solidified liquid LLW and solid LLW comprised of sealant residues, contaminated reagent containers, deformed Pu shipping containers, wipes, rags, and paper clothing would result in approximately 5 m^3 (6 yd^3) of LLW that would require disposal at a DOE LLW disposal facility. It would take approximately 4 years to accumulate sufficient quantity for one truck shipment. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.001 ha/yr (0.003 acre/yr) at Hanford and ORR, 0.0008 ha/yr (0.002 acre/yr) at NTS and INEL, and 0.0005 ha/yr (0.001 acre/yr) at SRS. The ultimate disposal of LLW will be in accordance with waste-type-specific ROD(s) from the Waste Management PEIS.

Approximately 110 m^3 (29,000 gal) of liquid hazardous waste consisting of 2 m^3 (500 gal) of chemical makeup and reagents from the surface facility and 108 m^3 (28,500 gal) of oil, antifreeze, and hydraulic fluid from the drilling and emplacing-borehole sealing facilities would be treated onsite or collected in DOT-approved containers and shipped to offsite RCRA-permitted treatment facilities. After treatment, the waste would be disposed of off-site in commercial, RCRA-permitted disposal facilities. An estimated 17 m^3 (22 yd^3) of solid hazardous waste such as wipes contaminated with oils, lubricants, and cleaning solvents would be compacted as appropriate and then packaged in DOT-approved containers treated onsite or offsite, and shipped to offsite RCRA-permitted treatment and disposal facilities.

Approximately $10,600 \text{ m}^3$ (2.8 million gal) of liquid nonhazardous sanitary and industrial wastewater and $6,800 \text{ m}^3$ (1.8 million gal) of steam plant blowdown and evaporator condensate would require treatment in accordance with standard industrial practices. Treated wastewater would be designated as reclaimed water recycle and would be used as makeup to the cooling tower. Construction of sanitary, utility, and process wastewater treatment systems would be required. The 306 m^3 (400 yd^3) of solid nonhazardous waste such as paper, glass, discarded office material, and cafeteria waste would be shipped to a permitted landfill. The drilling and emplacing-borehole sealing facilities would generate approximately $1,250 \text{ m}^3$ ($1,630 \text{ yd}^3$) of rock cuttings, bentonite and polymers. As per customary drilling industry practices, these wastes would end up in mud pits that would then be filled with earth and leveled.

4.3.3.2 Immobilized Disposition Alternative

The environmental impacts described in the following sections are based on the analysis of two facilities for the Immobilized Disposition Alternative. These two facilities are the ceramic immobilization facility (Section 4.3.3.2.1) and the deep borehole complex (Section 4.3.3.2.2).

4.3.3.2.1 Ceramic Immobilization Facility (for Borehole)

The environmental impacts described in the following sections are based on the analysis of the ceramic immobilization facility for the Immobilized Disposition Alternative as described in Section 2.4.3.2.1. No radioactive isotopes would be included in the ceramic matrix. The representative sites used for this analysis are Hanford, NTS, INEL, Pantex, ORR, and SRS.

4.3.3.2.1.1 Land Resources

A new ceramic immobilization facility would disturb 28.3 ha (70 acres) of land during construction of which 18.2 ha (45 acres) would be used during operations. The need for buffer zones would be determined during site-specific, tiered NEPA documentation. This section describes the impacts of constructing and operating the ceramic immobilization facility to land resources for each representative site.

Construction and operation of the ceramic immobilization facility should not cause indirect land use impacts at the analysis sites. As discussed in Section 4.3.3.2.1.8, in-migration of workers would be required during the operational phase at all sites analyzed. In-migration would occur during construction only at INEL and Pantex. However, it is expected that historic housing construction rates at each analysis site should accommodate the in-migrating population. Therefore, offsite land use at the analysis sites would not be affected.

Hanford Site

Land Use. The ceramic immobilization facility would utilize vacant land in the 200 Area adjacent to 200 East. Construction and operation of the ceramic immobilization facility would be in conformance with the existing and future land use as described in the current *Hanford Site Development Plan* and with ongoing discussions in the comprehensive land-use planning process. According to the *Hanford Site Development Plan*, 200 Area's land use is identified as waste operations, which includes radioactive material management, processing, and storage (HF DOE 1993c:13,14). [Text deleted.]

Construction and operation would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. Construction and operation of the facility would be compatible with State and local (Benton, Franklin, and Grant Counties and the City of Richland) land use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction and operation would be consistent with the industrialized landscape character of the 200 Areas and current VRM Class 5 designation. A potential visual impact during operation would be from stack plumes which could be visible from public viewpoints with high sensitivity levels including State Highways 24 and 240, and the City of Richland; however, because of the viewing distance and compatibility of the proposal with existing industrial character, visual impacts would not occur.

Nevada Test Site

Land Use. The ceramic immobilization facility would be on undeveloped land in Area 6 adjacent to the DAF. Construction and operation of the facility in Area 6 would not be in conformance with the *Nevada Test Site Development Plan*, which designates the southeast area of NTS as a nonnuclear test area. [Text deleted.] However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as

part of the NTS defense program material disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8,3-9; NT DOE 1996e:A-18). [Text deleted.]

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, and controls of adjacent jurisdictions since none of these counties or municipalities currently undertake land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. [Text deleted.] Views of the proposed action would be blocked from sensitive viewpoints accessible to the public by mountainous terrain.

Idaho National Engineering Laboratory

Land Use. The ceramic immobilization facility would be located on undeveloped land in the ICPP security area, which is situated within the central core area/Prime Development Land Zone of INEL (IN DOE 1992g:12). Construction and operation of the facility would be consistent with the current *Idaho National Engineering Laboratory Site Development Plan*, which designates the future land use of the ICPP as receiving and storing spent nuclear fuels and radioactive wastes (IN DOE 1994d:9-8). [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction would not be in conflict with land-use plans, policies, and controls of adjacent counties and the City of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operations would be compatible with the present visual character of INEL, which consists of large industrial facilities and stack plumes. Potential visual impacts during operation could occur from the additional stack plumes; however, the proposal would be consistent with the existing Class 5 industrial character of the ICPP.

Pantex Plant

Land Use. The ceramic immobilization facility would be located on undeveloped land in Zone 4. The potential action would be inconsistent with the current *Pantex Site Development Plan* master plan, which designates Zone 4 for weapons and weapon components staging (PX DOE 1995g:16). However, Pantex could revise the site development plan should Pantex be selected for this alternative.

Construction and operation would not affect other Pantex or offsite land uses. There would be no impacts to prime farmland. The alternative would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] Potential visual impacts could occur during operation from the additional stack plumes; however, the visual environment would be consistent with the existing industrialized landscape character, and current VRM Class 5 designation of Zone 4.

Oak Ridge Reservation

Land Use. The ceramic immobilization facility would be located on undeveloped land at the northwest quadrant of the Route 95/Bear Creek Road intersection. The alternative would be in conformance with the future land-use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan*, which designates a portion of the site as a major waste management area (OR DOE 1991f:1-7). Vacant land would be used. [Text deleted.]

Construction and operation would be compatible with other ORR and offsite land uses. No prime farmlands exist onsite. The ceramic immobilization facility would not be in conflict with city of Oak Ridge land use plans, policies, and controls since the current *Oak Ridge Area Land Use Plan* designates the potential site for Industrial and Public land use.

Visual Resources. [Text deleted.] Construction and operation of the facility would change the current VRM Class 4 designation of the Bear Creek Road/Route 95 site to Class 5. Additionally, potential visual impacts could occur during operation from the new stack plumes. Construction and operation activities would be highly visible from Bear Creek Road and Route 95, public roadways with high sensitivity levels.

Savannah River Site

Land Use. A new ceramic immobilization facility would be located on undeveloped land in the F-Area. Facility construction and operation would conform with existing and future land use as designated by the current *Savannah River Site Development Plan*. According to the plan, current F-Area land use is designated industrial operations, while the future land use category is primary industrial mission. Specifically, the F-Area is one of four SRS Waste Management facilities (SR DOE 1994d:2,11,12). Vacant land would be used.

Construction and operation would not affect other SRS or offsite land uses. There is no prime farmland on SRS. Construction would not be in conflict with land-use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. [Text deleted.] Construction and operation would occur within an area of similar industrial landscape character. Potential visual impacts could occur during operation from additional stack plumes; however, the proposal would be consistent with the VRM Class 5 designation of the F-Area.

[Text deleted.]

4.3.3.2.1.2 Site Infrastructure

The potential impacts to the site infrastructure at six representative DOE sites for construction and operation of a ceramic immobilization facility are described below. Data for construction and annual operations are presented in Appendix C. Site infrastructure changes resulting from such construction are presented in Table 4.3.3.2.1.2-1 and changes from operations in Table 4.3.3.2.1.2-2 for the six representative sites.

Hanford Site

[Text deleted.] Construction and operation of this new facility would require construction of transportation links to the existing road and rail networks. DOE would site this facility close to existing roads and railroads to ensure that such construction and operations impacts would be negligible to the site infrastructure. Hanford would require additional natural gas supplies to operate the ceramic immobilization facility. Since natural gas availability is governed by usage and not by storage capacity onsite, the additional natural gas required for operations could be procured through normal contractual means.

Nevada Test Site

[Text deleted.] Construction and operation of this new facility would require construction of transportation links to the existing road and rail networks. Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers. Since NTS does not use natural gas, this facility would be designed to burn fuel oil if NTS were selected as the site. [Text deleted.]

Idaho National Engineering Laboratory

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. INEL plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts would be negligible to the site infrastructure. Since INEL does not use natural gas, this facility would be designed to burn fuel oil if INEL were selected as the ceramic immobilization facility site.

Pantex Plant

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE would site this facility close to existing roads and railroads to ensure that such construction and operations impacts would be negligible to the site infrastructure. Additional oil would be required during the period of construction. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required for construction could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers.

Oak Ridge Reservation

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE would site this facility close to existing roads and railroads to ensure that such construction and operation impacts would be negligible to the site infrastructure. Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers for construction use.

Savannah River Site

[Text deleted.] Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers for construction use. Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE would site this facility close to existing roads and railroads to ensure that such construction and operations impacts would be negligible to the site infrastructure. Since SRS does not use natural gas, this facility would be designed to burn fuel oil if SRS were selected as the site.

Table 4.3.3.2.1.2-1. Additional Site Infrastructure Needed for the Construction of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative (Annual)

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	10,200	2	3,000,000	0	0
Hanford					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	355,700	60	12,334,800	21,039,531	0
Amount required in excess to site availability	0	0	0	0	0
NTS					
Site availability	176,844	45	5,716,000	0	0
Projected usage without facility	124,940	25	5,716,000	0	0
Projected usage with facility	135,140	27	8,716,000	0	0
Amount required in excess to site availability	0	0	3,000,000 ^a	0	0
INEL					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage without facility	232,500	42	5,820,000	0	11,340
Projected usage with facility	242,700	44	8,820,000	0	11,340
Amount required in excess to site availability	0	0	0	0	0

Table 4.3.3.2.1.2-1. Additional Site Infrastructure Needed for the Construction of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative (Annual)—Continued

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Pantex					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	46,266	10	795,166	7,200,000	0
Projected usage with facility	56,466	12.1	3,795,166	7,200,000	0
Amount required in excess to site availability	0	0	2,019,446 ^a	0	0
ORR					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	736,200	112	3,379,000	95,000,000	16,300
Amount required in excess to site availability	0	0	2,963,000 ^a	0	0
SRS					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	794,000	116	28,390,500	0	221,352
Projected usage with facility	804,200	118	31,390,500	0	221,352
Amount required in excess to site availability	0	0	3,000,000 ^a	0	0

^a Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996e; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

Table 4.3.3.2.1.2–2. Additional Site Infrastructure Needed for the Operation of the Ceramic Immobilization Facility (for Borehole)—Immobilized Disposition Alternative (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	< 5	< 5	35,000	5	210,000	3,800,000	0
Hanford							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	420	204	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	425	209	380,500	63	9,544,800	24,839,531	0
Amount required in excess to site availability	< 5	< 5	0	0	0	3,800,000 ^a	0
NTS							
Site availability	1,100 ^b	0	176,844	45	5,716,000	0	0
Projected usage without facility	645	0	124,940	25	5,716,000	0	0
Projected usage with facility	650	<5	159,940	30	5,926,000	3,800,000	0
Amount required in excess to site availability	0	< 5	0	0	210,000 ^c	3,800,000 ^a	0
INEL							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage without facility	445	48	232,500	42	5,820,000	0	11,340
Projected usage with facility	450	53	267,500	47	6,030,000	3,800,000	11,340
Amount required in excess to site availability	< 5	< 5	0	0	0	3,800,000 ^a	0
Pantex							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	76	27	46,266	10	795,166	7,200,000	0
Projected usage with facility	81	32	81,266	15	1,005,166	11,000,000	0
Amount required in excess to site availability	< 5	< 5	0	0	0	0	0
ORR							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	71	27	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	76	32	761,000	115	589,000	98,800,000	16,300
Amount required in excess to site availability	< 5	< 5	0	0	173,000 ^c	0	0

Table 4.3.3.2.1.2–2. Additional Site Infrastructure Needed for the Operation of the Ceramic Immobilization Facility (for Borehole)—Immobilized Disposition Alternative (Annual)—Continued

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
SRS							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	230	103	794,000	116	28,390,500	0	221,352
Projected usage with facility	235	108	829,000	121	28,600,500	3,800,000	221,352
Amount required in excess to site availability	< 5	< 5	0	0	210,000 ^c	3,800,000 ^a	0

^a Facility would be adapted to use fuel oil instead of natural gas.

^b Includes paved and unpaved roads.

^c Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996e; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SRS 1995a:2.

4.3.3.2.1.3 Air Quality and Noise

Construction and operation of the ceramic immobilization facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.3.2.1.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM₁₀ and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction.

Emission rates for operation of the ceramic immobilization facility are presented in Table F.1.3–8. Air pollutant emissions sources associated with operations include the following:

- Increased operation of existing boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators

[Text deleted.]

During operation, concentrations of criteria air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for facility operation plus the No Action concentrations are presented in Table 4.3.3.2.1.3–1. There are no toxic/hazardous chemical emissions associated with this facility.

NOISE

The location of the facilities associated with the ceramic immobilization facility relative to the site boundary and sensitive receptors was examined for each of the sites to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Non-traffic noise sources associated with operation of these facilities include ventilation systems, cooling systems, and material handling equipment. These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the sites,

Table 4.3.3.2.1.3-1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Ceramic Immobilization Facility and No Action Alternative (For Borehole)—Immobilized Disposition Alternative

Most Stringent Regulations or Guidelines ^a (µg/m ³)			Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)
Pollutant	Averaging Time													
Criteria pollutant														
Carbon monoxide	8-hour	10,000	0.08	5.15	2,290	2,294.03	284	296.7	602	650.7	5	6.26	22	65.35
	1-hour	40,000	0.3	40.58	2,748	2,776.46	614	646.2	2,900	3,155	11	13.6	171	375.1
Lead	Calendar Quarter	1.5	<0.01	b	b	b	0.001	0.001	0.09	0.09	0.05	0.05	<0.01	<0.01
	24-hour	0.5	<0.01	<0.01	c	c	c	c	c	c	c	c	c	c
Nitrogen dioxide	Annual	100	0.03	0.08	b	0.01 ^d	4	4.07	2.15	2.43	3	3.01	5.7	5.92
	1-hour	235	e	e	e	e	e	e	e	e	e	e	e	e
Particulate matter less than or equal to 10 microns in diameter	Annual	50	<0.01	<0.01	9.4	9.4	5	5	8.73	8.74	1	1	3	3.01
Sulfur dioxide	24-hour	150	0.02	0.04	106	106	80	80.06	88.5	88.71	2	2.01	50.6	50.79
	Annual	52	<0.01	<0.01	8.4	8.4	6	6	<0.01	0.03	2	2	14.5	14.51
	24-hour	260	<0.01	0.04	94.6	94.62	135	135.1	<0.01	0.28	32.01	32.01	196	196.24
	3-hour	1,300	0.01	0.22	725	725.1	579	579.3	<0.01	1.50	80	80.03	823	824.53
	1-hour	1,018	0.02	0.65	c	c	c	c	c	c	c	c	c	c
Mandated by State	1-hour	655 ^f	0.02	0.65	c	c	c	c	c	c	c	c	c	c
	30-minute	1,045	c	c	c	c	c	c	<0.01	4	c	c	c	c
	30-day	0.8	b	b	c	c	c	c	<0.75	<0.75	0.2	0.2	0.09	0.09
Hydrogen fluorides (as HF)	7-day	1.6	b	b	c	c	c	c	<0.75	<0.75	0.3	0.3	0.39	0.39
	24-hour	2.9	b	b	c	c	c	c	0.75	0.75	0.6 ^g	0.6 ^g	1.04	1.04
	12-hour	3.7	b	b	c	c	c	c	1.05	1.05	0.6 ^g	0.6 ^g	1.99	1.99
	8-hour	250	b	b	c	c	c	c	c	c	0.6	0.6	c	c
	3-hour	4.9	b	b	c	c	c	c	4.21	4.21	c	c	c	c

Table 4.3.3.2.1.3-1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Ceramic Immobilization Facility and No Action Alternative (For Borehole)—Immobilized Disposition Alternative—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines ^a ($\mu\text{g}/\text{m}^3$)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action ($\mu\text{g}/\text{m}^3$)	Total ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)	Total ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)	Total ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)	Total ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)	Total ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)	Total ($\mu\text{g}/\text{m}^3$)
Hydrogen sulfide	1-hour	112	c	c	b	b	c	c	c	c	c	c	c	c
	30-minute	111	c	c	c	c	c	c	b	b	c	c	c	c
Total suspended particulates	Annual	60	<0.01	<0.01	c	c	5	5	c	c	c	c	12.6	12.61
	24-hour	150	0.02	0.04	c	c	80	80.06	c	c	2	2.01	c	c
	3-hour	200	c	c	c	c	c	c	b	1.19 ^d	c	c	c	c
	1-hour	400	c	c	c	c	c	c	b	3.20 ^d	c	c	c	c
[Text deleted.]														

^a The more stringent of the Federal and State standards is presented for the averaging time.

^b No sources of this pollutant have been identified.

^c No State standard for indicated averaging time.

^d The concentration represents the alternative contribution only.

^e Ozone, as a criteria pollutant, is not directly emitted nor monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

^f At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.

^g 8-hour averaging time concentration was used.

[Text deleted.]

Note: Total concentrations are based on site contribution, including concentrations from ongoing activities (No Actions), and do not include the contribution from non-facility sources.

Concentrations for other hazardous/toxic pollutants reported for No Action in Section 4.2 are unchanged for this alternative and are not shown here.

Source: 40 CFR 50; ID DHW 1995a; ID DHW 1995b; LLNL 1996e; LLNL 1996f; NV DCNR 1995a; SC DHEC 1991a; SC DHEC 1992b; TN DEC 1994a; TN DHE 1991a; TX ACB 1987a; TX NRCC 1992a; TX NRCC 1995a; WA Ecology 1994a.

noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.3.2.1.4 Water Resources

The construction and operation of a ceramic immobilization facility would affect water resources. Water resource requirements, and discharges provided in Tables C.1.1.3–3 and C.2.1.3–3 and Table E.3.3.3–1, were used to assess impacts to surface water and groundwater. The discussion of impacts is provided for each site separately. Table 4.3.3.2.1.4–1 presents No Action surface and groundwater uses and discharges at each site, and the potential changes to water resources resulting from construction and operation of the ceramic immobilization facility.

Hanford Site

Surface Water. Surface water would be used as the water source for construction and operation of the ceramic immobilization facility, and would be obtained from the Columbia River. During construction, the quantity of water required would be approximately 38 million l/yr (10 million gal/yr), which would represent less than a 0.3-percent increase over the existing annual surface water withdrawal. These additional withdrawals would cause negligible impact to surface water availability.

During operation, water requirements for the ceramic immobilization facility would be approximately 320 million l/yr (84.5 million gal/yr), which would represent a 2.4-percent increase over the existing surface water withdrawal.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary and other nonhazardous wastewater (29.6 million l/yr [7.8 million gal/yr]), would be generated and discharged to percolation ponds at the 200 East Area. During operation, approximately 123.9 million l/yr (32.7 million gal/yr) of sanitary and other wastewater would also be discharged to percolation ponds. All discharges would be monitored. Percolation of this treated wastewater into the unconfined aquifer could contribute to the rising, or mounding, of the water table at the 200 Areas. However, no other impacts to the aquifer would be expected.

Other nonhazardous wastewater effluents (for example, steam condensate from heating, condensation from air conditioning, fire sprinkler water) would be collected, monitored, sampled, and treated as process wastewater, when required. The wastewater would be monitored for radioactivity, and if uncontaminated, discharged to percolation ponds or storm drains that discharge to local drainage channels. Impacts to the unconfined aquifer would be the same as discussed above.

The ceramic immobilization facility would be located in the 200 Area which is above the 100-year, 500-year and probable maximum flood boundaries; flooding from dam failures; and flooding from a landslide resulting in river blockage.

Groundwater. No groundwater would be used for any project-related water requirements; therefore groundwater availability would not be affected. Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater. Treated wastewater which does not evaporate, however, could percolate downward toward the groundwater of the unconfined aquifer. This water would be monitored and would not be discharged until contaminant levels are within the limits. Impacts to groundwater quality would, therefore, not be expected. In addition, other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Table 4.3.3.2.1.4-1. Potential Changes to Water Resources Resulting From Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Water Source	Surface	Ground	Ground	Ground	Surface	Ground
No Action Water Requirements (million l/yr)	13,511	2,400	7,570	249	14,760	13,247
No Action Wastewater Discharge (million l/yr)	246	82	540	141	2,277	700
Construction						
Water Availability and Use						
Total water requirement (million l/yr)	38	38	38	38	38	38
Percent increase in projected water use ^a	0.3	1.6	0.5	15.2	0.3	0.3
Water Quality						
Total wastewater discharge (million l/yr)	29.6	29.6	29.6	29.6	29.6	29.6
Percent change in wastewater discharge ^b	12	36.1	5.5	21	1.3	4.2
Percent change in streamflow	neg	NA	NA	NA	0.06 ^c	0.6 ^d
Operation						
Water Availability and Use						
Total water requirement (million l/yr)	320	320	320	320	320	320
Percent increase in projected water use ^e	2.4	13.3	4.2	129	2.2	2.4
Water Quality						
Total wastewater discharge (million l/yr)	123.9	123.9	123.9	123.9	123.9	123.9
Percent change in wastewater discharge ^f	50.4	151	22.9	87.9	5.4	17.7
Percent change in streamflow	neg	NA	NA	NA	0.3 ^c	2.5 ^d

Table 4.3.3.2.1.4-1. Potential Changes to Water Resources Resulting From Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative—Continued

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS
Floodplain						
Is action in 100-year floodplain?	No	No	No	No	No	No
Is critical action in 500-year floodplain?	No	Uncertain	Uncertain	No	Uncertain	Unlikely
^a Percent increases in water requirements during construction of the ceramic immobilization facility are calculated by dividing water requirements for the facility (38 million l/yr) with that for No Action water requirement at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr). ^b Percent changes in wastewater discharged during construction for the ceramic immobilization facility are calculated by dividing wastewater discharges for the facility (29.6 million l/yr) with that for No Action discharge at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr). ^c Percent changes in stream flow from wastewater discharges are calculated from the average flow of Clinch River (132 m³/s) and East Fork Poplar Creek (1.5 m³/s). The comparison for the East Fork Poplar Creek is shown in the table. ^d Percent changes in stream flow from wastewater discharges are calculated from the minimum flow of the Fourmile Branch (0.16 m³/s). ^e Percent increases in water requirements during operations of the ceramic immobilization facility are calculated by dividing water requirements for the facility (320 million l/yr) with that for No Action water requirement at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr). ^f Percent changes in wastewater discharged during operation of the ceramic immobilization facility are calculated by dividing wastewater discharge for the facility (123.9 million l/yr) with that for No Action discharge at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).						

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996e; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Nevada Test Site

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for construction and operation of the ceramic immobilization facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary and other nonhazardous wastewater (29.6 million l/yr [7.8 million gal/yr]) would be generated, treated, and discharged to evaporation/percolation ponds or be available for recycle. During operation, approximately 123.9 million l/yr (32.7 million gal/yr) of sanitary and other wastewater would be discharged to the wastewater treatment system and would then be available for recycle. Other nonhazardous wastewater effluents (for example, steam condensate from heating, condensation from air conditioning, fire sprinkler water) would be collected, monitored, sampled, and treated as process wastewater when required. This wastewater would be monitored for radioactivity, and if uncontaminated, would be available for recycling or discharge to local drainage channels.

Because there are no continuously flowing streams on NTS and no designated floodplains, there are no studies to assess the 500-year floodplain boundaries. Studies of the 100-year floodplain showed it to be confined to the Jackass Flats and Frenchman Lake areas. The site for the ceramic immobilization facility would not be located in either of these areas. However, since the NTS is in a region where most flooding occurs by locally intense thunderstorms which can create brief (less than 6 hours) flash floods, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater. Quantities required and the percent increase in projected water use are shown in Table 4.3.3.2.1.4-1. Annual construction water requirements for the facility (38 million l/yr [10 million gal/yr]), represent approximately 0.2 percent of the estimated minimal annual recharge (38 billion l/yr [10 billion gal/yr]) to the regional aquifer under the entire NTS. As shown in Table 4.3.3.2.1.4-1, the quantity of water which would be required for construction of the facility represents approximately a 1.6-percent increase over the projected No Action groundwater usage. Operating the facilities at NTS would require 320 million l/yr (84.5 million gal/yr), which is approximately 13.3 percent of the projected groundwater usage. This additional withdrawal would represent 0.8 percent of the estimated minimal annual recharge, and would increase the total amount withdrawn annually at NTS to 7.2 percent of the estimated annual recharge. These additional withdrawals would have minimal impacts on groundwater availability.

Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward into the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are therefore not expected. Other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the ceramic immobilization facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary and other nonhazardous wastewater (29.6 million l/yr [7.8 million gal/yr]), would be generated, treated, and discharged to evaporation/infiltration ponds or be available as recycle. During operation, a maximum of approximately 123.9 million l/yr (32.7 million gal/yr) of sanitary and other wastewater would be discharged to this wastewater treatment system. All discharges would be monitored to comply with discharge limits. Other nonhazardous wastewater effluents (for example, steam condensate from heating, condensation from air conditioning, fire sprinkler water) would be collected, monitored, sampled, and treated as process wastewater, when required. This wastewater would be monitored for radioactivity, and if uncontaminated, discharged to evaporation ponds or storm drains which discharge to local drainage channels.

The site for the ceramic immobilization facility is not located in an area historically prone to flooding, but is within the flood zone that could occur as a result of the failure of the MacKay Dam during a maximum probable flood. This flood event would be more critical than either the 100- or 500-year flood. Because INEL is in a region where flash floods could occur, the facility would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. During construction, water requirements for the facility (38 million l/yr [10 million gal/yr]) would represent a 0.5-percent increase over the projected annual groundwater usage. This would increase the total projected amount to be pumped at INEL to 17.7 percent of the total allotment. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). During operation, the water requirements for the facilities would be 320 million l/yr (84.5 million gal/yr). This amount would represent a 4.2-percent increase over the projected annual groundwater usage and would increase the total projected amount to be pumped at INEL to 18.3 percent of the total allotment. This increase should not have any impact on groundwater availability, as INEL would be well within its total allotment.

Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater and would not be expected to contribute to existing near surface contamination. Treated wastewater which does not evaporate, however, could percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged into the treatment ponds until contaminant levels are within the limits. Impacts to groundwater quality are therefore not expected. In addition, other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Pantex Plant

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with any of the facilities; groundwater would be used as the water source for construction and operation of the ceramic immobilization facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary and other nonhazardous wastewater (29.6 million l/yr [7.8 million gal/yr]), would be generated and discharged to the existing wastewater treatment systems north of Zone 12 and then discharged to the playa lakes or would be available for recycling. During operation, approximately 123.9 million l/yr (32.7 million gal/yr) of sanitary wastewater and other wastewater would be discharged to either of these wastewater treatment systems, and then discharged to the playa lakes or would be available for recycling. The expected quantity of additional wastewater potentially discharged to the playas during operation (approximately 339,500 l/day [89,700 gal/day]) should not cumulatively cause any exceedances of the monthly average limit of 2.46 million l/day (0.65 million gal/day). This is based on Pantex's 1994 discharges, which averaged approximately 1.4 million l/day (0.37 million gal/day), and are expected to decline in the future.

Other nonhazardous wastewater effluents (for example, steam condensate from heating, condensation from air conditioning, fire sprinkler water) would be collected, monitored, sampled, and treated as process wastewater, when required. This wastewater would be monitored for radioactivity, and if uncontaminated, discharged to natural drainage channels or the playas.

The proposed location for the ceramic immobilization facility is in Zone 4. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in Zone 4, there would be no impacts to floodplains. However, flooding at Pantex could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. All water required for construction and operation would be supplied from groundwater using the existing supply system which obtains water from the Ogallala Aquifer. Construction water requirements for the ceramic immobilization facility would be small relative to the recoverable water in aquifer storage, which for the year 2010 was estimated to be 287 trillion l (75.8 trillion gal) (PX WDB 1993a:1). As shown in Table 4.3.3.2.1.4-1, construction of the facility would require 38 million l/yr (10 million gal/yr) of water, which represents approximately a 15.2-percent increase over the projected annual No Action groundwater usage. [Text deleted.] Previous studies have shown that when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala Aquifer, an average of 1.8-m/yr (5.9-ft/yr) decline in the water table occurred over a 10-year period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the ceramic immobilization facility at Pantex would require 320 million l/yr (84.5 million gal/yr), which represents approximately a 129-percent increase over the projected annual No Action groundwater usage and 16.9 percent of the capacity of the groundwater system. The small additional drawdown attributed to this additional withdrawal would add to the declining groundwater levels in the area thus decreasing regional availability. The total site groundwater withdrawal including this facility would be 569 million l/yr (150.3 million gal/yr) which because of expected cutbacks in other programs, would be 32 percent less than the 836 million l/yr (221 million gal/yr) currently being withdrawn from wells at Pantex.

Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater. Treated wastewater discharged to playas, however, could percolate downward into the groundwater of the near surface aquifer. This water would be monitored and would not be discharged to the playas until contaminant levels are within the limits specified by the TNRCC. [Text deleted.]

Although the expected drawdowns caused by withdrawing the water required for this alternative are small, the overall decline in groundwater levels in the Amarillo area is of concern. Possible groundwater conservation measures at Pantex that could be considered include decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Oak Ridge Reservation

Surface Water. Water required for construction and operation of the ceramic immobilization facility would be provided by the Clinch River and its tributaries. Water required during construction would be approximately 38 million l/yr (10 million gal/yr) which would represent a 0.3-percent increase over the projected annual surface water withdrawal. This additional withdrawal would be approximately 0.0009 percent of the average flow of the Clinch River. During operation, water requirements would be approximately 320 million l/yr (84.5 million gal/yr) annually. This would represent a 2.2-percent increase over the projected annual surface water withdrawal. Including this increase, ORR's total annual withdrawal would be 0.4 percent of the average flow of the Clinch River ($132 \text{ m}^3/\text{s}$ [$4,647 \text{ ft}^3/\text{s}$]). These additional water withdrawals from the Clinch River

would cause negligible impacts to surface water availability. [Text deleted.] During construction of the ceramic immobilization facility, sanitary and other nonhazardous wastewater (approximately 29.6 million l/yr [7.8 million gal/yr]) would be generated, treated, and discharged to the East Fork Poplar Creek and would represent a 1.3-percent increase in the amount being discharged. During operation, a total of 123.9 million l/yr (32.7 million gal/yr) of wastewater would be generated by the facility. This quantity would represent 0.3 percent of the average flow of East Fork Poplar Creek and a 5.4-percent increase in the amount of wastewater being discharged. All discharges would be monitored to comply with discharge requirements. No impacts are expected. Other nonhazardous wastewater effluents (for example, steam condensate from heating, condensation from air conditioning, fire sprinkler water) would be collected, monitored, sampled, and treated as process wastewater, when required. This wastewater would be monitored for radioactivity, and if uncontaminated, discharged to storm drains which discharge to local drainage channels.

The potential location for the ceramic immobilization facility would be located outside of the 100-year floodplain. The 500-year floodplain has not been determined in this area but could be developed in future studies.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater; therefore, neither groundwater quality nor availability would be affected.

Savannah River Site

Surface Water. No surface water withdrawals would be made; groundwater would be used for all construction and operational needs of the ceramic immobilization facility. [Text deleted.] During construction of the ceramic immobilization facility, sanitary and other nonhazardous wastewater (approximately 29.6 million l/yr [7.8 million gal/yr]), would be generated and discharged to the sitewide wastewater treatment system which would not require any modifications. This wastewater would represent a 4.2-percent increase in the effluent from the site. During operation, approximately 123.9 million l/yr (32.7 million gal/yr) of sanitary wastewater would be discharged to this wastewater treatment system. This would represent a 17.7-percent increase in the projected effluent discharged to Fourmile Branch from this facility. This additional quantity would represent approximately 2.5 percent of Fourmile Branch's minimum flow. All discharges would be monitored to comply with discharge requirements. [Text deleted.] Other nonhazardous wastewater effluents (for example, steam condensate from heating, condensation from air conditioning, fire sprinkler water) would be collected, monitored for radioactivity, and if uncontaminated, discharged to storm drains which discharge to local drainage channels. If contaminated, this wastewater would then be transferred by pipeline or tanker to treatment facilities as required.

The potential location of the ceramic immobilization facility is outside the 100-year floodplain. Information on the location of the 500-year floodplain at SRS is currently available only for a limited number of specific project areas. However, the ceramic immobilization facility at SRS would not likely affect, or be affected by the 500-year floodplain of either the Fourmile Branch or Upper Three Runs Creek because the facility would be located at an elevation of about 91 m (300 ft) above MSL and is approximately 33 m (107 ft) and 64 m (210 ft) above these streams and at distances from these streams of 0.8 km (0.5 mi) to 1.5 km (0.94 mi), respectively. The maximum flow that has occurred on the Upper Three Runs Creek was in 1990, with a flow rate of about 58 m³/s (2,040 ft³/s). At that time the creek reached an elevation of almost 30 m (98 ft) above MSL (SR USGS 1996a:1). The elevations of the buildings in F-Area are more than 63 m (202 ft) above the highest flow elevation of the Upper Three Runs Creek. The maximum flow that has occurred on the Fourmile Branch was in 1991 with a rate of approximately 5 m³/s (186 ft³/s), and an elevation of about 61 m (199 ft) above MSL (SR USGS 1996a:1). Elevations of the buildings in F-Area are more than approximately 31 m (101 ft) higher than the maximum flow level that has occurred.

Groundwater. During construction, the quantity of water required would be approximately 38 million l/yr (10 million gal/yr) which would represent less than a 0.3-percent increase over the projected annual No Action groundwater withdrawal. This additional withdrawal should cause negligible impacts to groundwater availability. During operation, water used for cooling system makeup would be obtained from existing supply systems in the F-Area. The water for these systems is groundwater from the Cretaceous aquifer. The total annual water requirements during operations would be 320 million l/yr (84.5 million gal/yr). As shown in Table 4.3.3.2.1.4–1, this would represent a 2.4-percent increase in the projected No Action groundwater usage at SRS. These additional water withdrawals from groundwater would not impact regional groundwater levels. Previous studies using numerical simulations of groundwater withdrawals up to 6 times greater than that required for the ceramic immobilization facilities from the Cretaceous aquifer indicate drawdown of almost 2.1 m (6.9 ft) at the well head, but smaller in overlying aquifers and not beyond SRS boundaries in any aquifer (DOE 1991c:5-196). Therefore, it is expected that the withdrawals attributed to these facilities would cause a small drawdown at the well head and would not impact aquifers in the area. No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected.

[Text deleted.]

4.3.3.2.1.5 *Geology and Soils*

This section describes the environmental impacts to the geologic and soils resource as related to the construction and operation of the ceramic immobilization facility. A ceramic immobilization facility, at any of the sites analyzed, would involve some ground-disturbing construction activities (28.3 ha [70 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. The relative amount of annual precipitation (rainfall) is greater at ORR and SRS than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on the geologic resource are anticipated. Neither facility construction and operational activities nor site infrastructure improvements would restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is low for Pantex, Hanford, INEL, and NTS. The soil erosion potential for ORR and SRS during construction and operational activities is moderate due primarily to the greater relative annual precipitation. Soil disturbance would occur primarily from ground-disturbing construction (foundation preparation) and activities associated with building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (increased wind velocities and durations increase potential soil erosion), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvements (buildings, roads and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal. Indirect effects to the soil resource from infrastructure improvements would have a similar impact on the soil profile and erosion potential.

[Text deleted.]

4.3.3.2.1.6 Biological Resources

Construction of the ceramic immobilization facility would require 28.3 ha (70 acres) of land at each of the DOE sites analyzed. This includes areas on which plant facilities would be considered, as well as areas used for construction laydown. Consultation with USFWS and State agencies would be conducted in conjunction with the site-specific level of NEPA review, as appropriate, to avoid potential impacts to threatened and endangered species.

Hanford Site

It is assumed that the ceramic immobilization facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility would result in the disturbance of terrestrial habitat equaling about 0.02 percent of Hanford. This includes areas on which plant facilities would be constructed as well as areas that would be revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. The facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the ceramic immobilization facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds before construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the ceramic immobilization facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the ceramic immobilization facility would not affect wetlands since no wetlands exist near the assumed facility location. Groundwater would be used and wastewater would be discharged to evaporation/infiltration ponds; therefore, wetlands would not be affected.

Aquatic Resources. Construction of a ceramic immobilization facility at Hanford would not impact aquatic resources since there are no surface water bodies near the assumed facility location. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure so impacts to aquatic resources from impingement and entrainment would be minimal. Since the volume of water included represents a small percentage of the flow of the river, flow-related impacts to aquatic resources would be minimal. Wastewater would be discharged to evaporation/infiltration ponds; therefore, aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the ceramic immobilization facility; however, sagebrush

habitat would be disturbed. The sagebrush community is important nesting/breeding and foraging habitat for several State-listed and candidate species such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate prior to construction to determine the existence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the ceramic immobilization facility would be located in the Frenchman Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility at NTS would result in the disturbance of terrestrial resources equaling about 0.008 percent of NTS. This includes areas on which facilities would be constructed, as well as areas used for construction laydown. Vegetative cover within the assumed facility location, which is primarily creosote bush (Figure 3.3.6-1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the ceramic immobilization facility would affect animal populations. Less mobile animals, such as reptiles and small mammals, within the project area would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds before construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the ceramic immobilization facility would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the ceramic immobilization facility would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location.

Threatened and Endangered Species. The threatened desert tortoise is a federally listed species that could be affected by construction of the ceramic immobilization facility at NTS. Construction activities such as land clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicle traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training; putting restrictions on vehicle speeds and off-road movement; conducting clearance surveys before surface disturbance; approving stop work authority if tortoises are found within work areas; removing tortoises from roadways and work areas; placing permanent and temporary tortoise-proof fencing around trenches, landfills, and treatment ponds; inspecting trenches; and having biologists survey when heavy equipment is in use. The USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the ceramic immobilization facility.

[Text deleted.] Any listed plant species located within the construction area would be lost during land-clearing activities (Table 3.3.6-1). Preactivity surveys would be conducted as appropriate before construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicular traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on the NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the ceramic immobilization facility (Section 4.3.3.2.1.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that the ceramic immobilization facility would be constructed within an undeveloped portion of the ICPP area. The ICPP area falls within the big sagebrush/thickspike wheatgrass/needle-and-thread grass community. Impacts to wildlife would be limited to smaller mammals and some birds and reptiles which could be displaced or suffer mortality. Larger mammals are excluded from the assumed site by the perimeter fence and thus would not be impacted. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the area would have already adapted to similar disturbances. Due to the lack of wetlands or aquatic resources on the assumed facility location, these resources would not be affected by construction or operation of the ceramic immobilization facility. Since the facility would be located within the ICPP security area, impacts to threatened and endangered species would not be expected since they are not present at the ICPP.

Pantex Plant

It is assumed that the ceramic immobilization facility would be located within Zone 4 which is a developed area with minimal natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the site; however, small mammals and some birds and reptiles could be displaced by construction. Since the area does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the ceramic immobilization facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional wastewater could lead to a minor increase in open water near the outfall, as well as a change in plant species composition. No federally listed threatened or endangered species would be likely affected by construction or operation of the ceramic immobilization facility. Although the assumed site has been disturbed, it is possible that the State-listed Texas horned lizard could be present. Preactivity surveys would be conducted as appropriate before construction.

Oak Ridge Reservation

It is assumed that the ceramic immobilization facility would be located about 3 km (2 mi) east of the K-25 area of ORR. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility at ORR would result in the disturbance of terrestrial habitat equaling about 0.2 percent of ORR. Vegetation within the area to be developed would be destroyed during land clearing. Vegetation cover within the assumed site is predominantly oak-hickory forest or pine and pine-hardwood forest (Figure 3.6.6-1). While both types would be affected by construction, it is likely that a greater area of pine and pine-hardwood forests would be removed. This type of forest is more heavily concentrated in valleys where most of the development would occur. Oak-hickory forests are typically found on ridges. Both forest types are common throughout ORR and within the region.

Construction of the proposed facility would affect animal populations. Less mobile animals within the proposed project area, such as amphibians, reptiles, and smaller mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds before construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the proposed facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Because the majority of the area in which the proposed facility would be located is upland, it is expected that direct impacts to wetlands could be avoided. Implementation of erosion and sediment control measures would control secondary impacts. Since an existing intake structure would be used during both construction and operation, it would not be necessary to disturb wetlands along the Clinch River. However, a new wastewater discharge structure could be required on East Fork Poplar Creek. Depending on its location, this structure could displace some wetlands along the creek. Any unavoidable impact to wetlands would be mitigated according to DOE policy set forth in 10 CFR 1022 and in accordance with the requirements of a COE permit.

During construction and operation, discharges would be directed to East Fork Poplar Creek. Discharges would have a minimal impact on the flow of the stream and are not expected to affect associated wetlands. All wastewater discharges would be treated as necessary to meet NPDES permit requirements.

Aquatic Resources. Construction and operation of the ceramic immobilization facility could cause water quality changes (primarily sediment loading and resulting turbidity) to Bear Creek, Grassy Creek, or Ish Creek as a result of soil erosion. Soil erosion and sediment control measures would be implemented to control erosion. Water requirements during both construction and operation would be met by existing site sources. Since a new intake structure would not be required, direct disturbance to aquatic resources in the Clinch River would not occur. Water withdrawal during construction and operation would represent a very small percentage of the Clinch River's average flow and would have little effect on the flow of the river. Increases in impingement and entrainment impacts would, therefore, be minimal and would be unlikely to affect fish populations in the river.

During construction and operation, wastewater would be discharged to East Fork Poplar Creek. This could require the construction of a new discharge structure which would temporarily disturb aquatic habitat on the vicinity of the outfall. The small volume of wastewater discharged to the stream would not be expected to impact aquatic resources during either construction or operation. In addition, NPDES-permit requirements would be met. [Text deleted.]

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species are expected to be affected by construction of the ceramic immobilization facility. [Text deleted.] Land clearing activities may destroy State protected plant species found within or adjacent to disturbed portions of the proposed site including pink lady's-slippers, fen orchid, tubercled rein-orchid, American ginseng, purple fringeless orchid, Canada lily and golden seal. The Tennessee dace is sensitive to siltation and actively seeks clean gravel for spawning. An increase in amount or duration of sediment runoff to Ish Creek or Bear Creek during facility construction could impact this fish species. Preactivity surveys would be conducted as

appropriate before construction to determine the occurrence of special status species in the area to be disturbed. No additional impacts are expected during operation of the facility. [Text deleted.]

Savannah River Site

It is assumed that the ceramic immobilization facility would be constructed within the F-Area, which is one of the highly developed industrial areas of SRS. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area would have already adapted to similar disturbances. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since water would be taken from existing sources and discharged via NPDES-permitted outflows and would involve minor volumes. Construction and operation of the ceramic immobilization facility would not be expected to impact threatened and endangered species due to the developed nature of the assumed facility location. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the facility that this species would not be directly affected by this action.

4.3.3.2.1.7 Cultural and Paleontological Resources

This section discusses construction and operational impacts to cultural and paleontological resources that may result from the ceramic immobilization facility at each of the representative sites analyzed. The total land disturbed for this facility is 28.3 ha (70 acres) during construction of which 18.2 ha (45 acres) would be used during operation. [Text deleted.] For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources were identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. Any such sites may be identified through additional surveys. Any identified sites would be avoided. Operation would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified close to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The ceramic immobilization facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed lands necessary for the proposed facility may contain similar prehistoric or historic resources. Impacts to resources would occur during construction, but not operation, of the facility.

The CGTO has conducted surveys over portions of Frenchman Flat and has identified at least 20 plant species of importance to Native Americans there. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from facility construction and operation. Potential impacts include reduced access to traditional use areas and visual or auditory intrusions to sacred space or ceremonial space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological remains may be affected by construction, but not operation, of the facility.

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The facility would be constructed within the existing ICPP security area. No sites have been identified through surface surveys of the area. Because the ICPP is developed and disturbed, it is unlikely to contain subsurface

cultural deposits. Impacts to NRHP-eligible sites are not anticipated during construction or operation of the facility.

Some Native American resources such as traditional use areas and sacred space may be affected by the construction of the facility. For example, construction and operation could create auditory or visual impacts to important Native American resources in the vicinity. Resources would be identified through consultation with the potentially affected tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River Floodplain which have produced fossilized remains. Operation would not have an additional effect on these resources.

Pantex Plant

The ceramic immobilization facility would be constructed in Zone 4 of Pantex. A historic buildings survey was conducted in Zone 4 to identify significant World War II Era structures and none of the buildings there are considered NRHP eligible on that basis. [Text deleted.] Archaeological surveys would be conducted on any unsurveyed areas that would be affected by construction prior to ground-breaking activities. Because the area is developed and disturbed, it is unlikely to contain NRHP-eligible archaeological resources. Recorded prehistoric site types at Pantex include lithic scatters, hunting/kill sites, and concentrations of fire-cracked rock. Sites are located predominantly near the playas. Historic sites are generally associated with farming, such as remains of homes and outbuildings as well as World War II and Cold War Era structures. Resources such as these may occur on the land to be disturbed during construction. Operation would not result in any additional impact to prehistoric or historic resources.

DOE has initiated a public outreach program at Pantex to involve Native American groups in decisionmaking related to land use and cultural resources. To date, none of the Native American tribes known to have traditional interest in Pantex lands have identified any sacred sites, ceremonial areas, or cemeteries near Zone 4. Additional consultation may identify some of these resources. Resources such as cemeteries could be affected by new construction. Operation could have an auditory or visual impact on sacred or ceremonial sites.

Important paleontological remains such as bison and camel bones have been found in other areas of the High Plains and it is possible that some may occur in lands to be disturbed by construction at Pantex. Operation would not have an additional effect on these resources.

Oak Ridge Reservation

This facility would be constructed at the intersection of Route 95 and Bear Creek Road. A portion of the proposed project area on both sides of Bear Creek Road was surveyed in association with the proposed Exxon Nuclear Facility, which was never built (OR UTN 1975a:ii). Some prehistoric sites were identified near the Clinch River, and the potential for sites along the smaller creeks exists. In addition, remains of a number of 20th-century frame houses and mid-to-late 19th century log houses and outbuildings are located within the project area. Survey work would be conducted prior to construction on any unsurveyed lands to be affected by construction. Prehistoric site types that are known to occur at ORR include remains of prehistoric villages, burial grounds, quarries and lithic workshops, and shell scatters. Historic resources may include standing structures, as well as remains of dwellings, road traces, cemeteries, and trash scatters. Resources such as these may occur in the area and may be affected by construction, but not operation, of the facility.

Some Native American resources may be affected by construction and operation of the facility. These resources, should any exist, would be identified through consultation with the potentially affected tribes. For example, construction could affect traditionally used plant and animal species. Operation may result in reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Fossilized remains occur at ORR. Some of these may exist in areas to be disturbed during construction. However, any impacts would be considered negligible because the fossil assemblages at ORR consist of common invertebrates with low research potential. Operation would not affect paleontological remains.

Savannah River Site

The ceramic immobilization facility would be located in open space within F-Area. Portions of F-Area have been surveyed and contain sites potentially eligible for the NRHP. Additional surveys would be conducted in unsurveyed areas to be disturbed by construction. Site types known to occur at SRS include remains of prehistoric base camps, quarries, and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by construction but not operation.

Some Native American resources may be affected by the proposed action. Construction may affect resources such as prehistoric sites, cemeteries, and traditional plants. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to the areas may also result from facility construction and operation. Any resources would be identified through consultation with the potentially affected tribes.

No scientifically valuable paleontological resources have been recorded at SRS to date. Facility construction and operation are not expected to have an effect on paleontological resources.

| [Text deleted.]

4.3.3.2.1.8 Socioeconomics

This section analyzes the socioeconomic effects of the ceramic immobilization facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. The effects at all of the candidate sites are found in the Supplemental Socioeconomic Data Report (Socio 1996a).

Regional Economy Characteristics. Constructing the ceramic immobilization facility at any of the sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 1,000 workers in the peak year of construction at any site. The largest increases in regional employment (about 1 percent) and regional per capita income (much less than 1 percent) would occur at INEL. A total of 2,030 new jobs (1,000 direct and 1,030 indirect) would be generated and regional unemployment would fall from 5.4 to 4.5 percent (Socio 1996a).

A workforce of 900 would be required during full operation at any site. Operating the facility would generate larger socioeconomic changes than would construction, due to the larger, more permanent workforce. Implementing the alternative at INEL would generate the largest increases in regional employment (about 2 percent) and in the per capita income (about 1 percent). A total of 3,314 new jobs (900 direct and 2,414 indirect) would be created by the operational activities, and regional unemployment would fall to 3.8 percent in the INEL REA (Socio 1996a).

Population and Housing. At all of the sites analyzed, except Pantex and INEL, construction employment requirements would be met by the available resident labor force. Some in-migrating workers would be needed to fill more specialized positions during operation at all of the sites analyzed. Project-related in-migration would produce the largest population increases in the INEL ROI during construction of the facility. Pantex, however, would require the largest number of in-migrating workers for operation. These population increases in either the INEL or Pantex ROI, however would be less than 1 percent above No Action.

Housing units, in excess of existing vacancies, would be required in the INEL and Pantex ROIs during construction of the project. Additional housing construction would also be required at all of the sites analyzed, except NTS, during operation to accommodate the in-migrating population. The greatest increase in housing requirements (less than 1 percent) during construction and operation would be in the INEL ROI. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the in-migrating population at all of the analyzed sites. (Socio 1996a).

Community Services. During construction, only the Pantex and INEL ROIs would experience an increase in demand for community services. However, operation of the facility would slightly increase the demand for community services at all sites analyzed. The effects of population growth due to in-migrating workers during operation would be minor at all of the sites analyzed. The following discussion focuses on the INEL and Pantex ROIs which would experience the largest increases in demand for community services.

To maintain the student-to-teacher ratio of 18.5:1 in the INEL ROI, 18 additional teachers would be needed during construction of the facility. In the Pantex ROI, 22 additional teachers would be needed during operation to maintain the No Action student-to-teacher ratio of 16.3:1. These increases in teacher requirements, however, would be distributed over several school districts in the respective ROIs, and no single school district would be significantly affected (Socio 1996a).

To maintain No Action service levels of 1.6 police officers and 2.2 firefighters per 1,000 persons in the INEL ROI, two additional police officers and three new firefighters would be needed during construction. Two additional police officers and four additional firefighters at Pantex would be needed to maintain No Action levels of service of 2.3 police officers and 2.3 firefighters per 1,000 persons during operations (Socio 1996a).

Projected hospital occupancy rates would increase slightly over the No Action levels. However, projected capacity would be capable of accommodating these small increases in patient load. Only two additional physicians would be needed in the INEL ROI during construction and four physicians would be needed in the Pantex ROI during operation to maintain the No Action service level of 1.2 and 2.0 physicians per 1,000 persons, respectively (Socio 1996a).

Local Transportation. Traffic generated during construction of the immobilization facility would affect INEL and ORR local road segments. U.S. 20/26 between U.S. 26 East and Idaho State Route 22/33 near INEL would experience a drop in level of service from B to C. Tennessee State Route 62 from Tennessee State Route 95 at Oak Ridge to Tennessee State Route 170 would experience a significant increase in volume-to-capacity ratio and the level of service would remain F.

During the facility operations phase, INEL would experience a drop in level of service on one road segment. U.S. 20/26 between U.S. 26 East and Idaho State Route 22/33 near INEL would experience a drop in level of service from B to C. (Socio 1996a).

4.3.3.2.1.9 Public and Occupational Health and Safety

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the ceramic immobilization facility. The section first describes the impacts from normal facility operation at each potential site, followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation of the immobilization facility during the assumed 10-year campaign time are presented in Tables 4.3.3.2.1.9–1 and 4.3.3.2.1.9–2, respectively. [Text deleted.] Impacts from hazardous chemicals to these same groups are given in Table 4.3.3.2.1.9–3. Summaries of impacts associated with postulated accidents are given in Tables 4.3.3.2.1.9–4 through Table 4.3.3.2.1.9–9. Detailed results are presented in Section M.

Normal Operation. There would be no radiological releases during the construction of a ceramic immobilization facility at any of the sites analyzed. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the ceramic immobilization facility at each of the sites are presented in Table 4.3.3.2.1.9–1. The impacts from all site operations, including the ceramic immobilization facility, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The doses to the maximally exposed member of the public from annual ceramic immobilization facility operation range from 1.6×10^{-8} mrem at the NTS site to 5.9×10^{-7} mrem at the ORR site. From 10 years of operation, the corresponding risks of fatal cancer to this individual would range from 8.0×10^{-14} to 3.0×10^{-12} . The impacts to the average individual would be less. As a result of annual facility operations, the population doses would range 3.3×10^{-8} person-rem at the NTS site to 1.2×10^{-5} person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 1.7×10^{-10} to 6.0×10^{-8} .

The doses to the maximally exposed member of the public from annual total site operations are all within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would range from 6.1×10^{-5} mrem at Pantex to 3.2 mrem at ORR. From 10 years of operation, the corresponding risks of fatal cancers to this individual would range from 3.1×10^{-10} to 1.6×10^{-5} . The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operation, the population doses would be within the limit in proposed 10 CFR 834, and would range from 2.8×10^{-4} person-rem at Pantex to 44 person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 1.4×10^{-6} to 0.22.

Doses to onsite workers from normal operations are given in Table 4.3.3.2.1.9–2. Included are involved workers directly associated with the ceramic immobilization facility, workers who are not involved with the ceramic immobilization facility, and the entire workforce at each site. All doses fall within regulatory limits.

The annual dose to ceramic immobilization facility workers is site-independent and would be 244 mrem to the average facility worker and 110 person-rem to the entire facility workforce. The annual dose to the average

Table 4.3.3.2.1.9-1. Potential Radiological Impacts to the Public During Normal Operation of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative

Receptor	Hanford			NTS			INEL			Pantex			ORR			SRS		
	Facility	Site ^a	Total	Facility	Site ^a	Total	Facility	Site ^a	Total	Facility	Site ^a	Total	Facility	Site ^a	Total	Facility	Site ^a	Total
Annual Dose to the Maximally Exposed Individual Member of the Public^b																		
Atmospheric release pathway (mrem)	3.2x10 ⁻⁸	4.4x10 ⁻³	1.6x10 ⁻⁸	1.6x10 ⁻⁸	4.2x10 ⁻³	2.0x10 ⁻⁸	0.018	2.5x10 ⁻⁷	6.1x10 ⁻⁵	5.9x10 ⁻⁷	1.5	1.8x10 ⁻⁷	0.42					
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0	0	0	0	0	0.081					
Total liquid release pathway (mrem)	0	9.5x10 ⁻⁴	0	0	0	0	0	0	0	0	0	0	0.37					
Atmospheric and liquid release pathways combined (mrem)	3.2x10 ⁻⁸	5.3x10 ⁻³	1.6x10 ⁻⁸	1.6x10 ⁻⁸	4.2x10 ⁻³	2.0x10 ⁻⁸	0.018	2.5x10 ⁻⁷	6.1x10 ⁻⁵	5.9x10 ⁻⁷	3.2	1.8x10 ⁻⁷	0.79					
Percent of natural background ^c	1.1x10 ⁻⁸	1.8x10 ⁻³	5.1x10 ⁻⁹	5.9x10 ⁻⁹	1.3x10 ⁻³	5.2x10 ⁻³	5.2x10 ⁻³	7.5x10 ⁻⁸	1.8x10 ⁻⁵	2.0x10 ⁻⁷	1.1	6.0x10 ⁻⁸	0.27					
10-year fatal annual cancer risk	1.6x10 ⁻¹³	2.7x10 ⁻⁸	8.0x10 ⁻¹⁴	1.0x10 ⁻¹³	2.1x10 ⁻⁸	8.9x10 ⁻⁸	8.9x10 ⁻⁸	1.3x10 ⁻¹²	3.1x10 ⁻¹⁰	3.0x10 ⁻¹²	1.6x10 ⁻⁵	9.0x10 ⁻¹³	4.0x10 ⁻⁶					
Annual Population Dose Within 80 Kilometers^d																		
Atmospheric release pathway (person-rem)	1.5x10 ⁻⁶	0.46	3.3x10 ⁻⁸	3.7x10 ⁻³	2.3x10 ⁻⁷	2.4	6.3x10 ⁻⁷	2.8x10 ⁻⁴	1.1x10 ⁻⁵	29	1.2x10 ⁻⁵	40						
Total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	0	4.7	3.6						
Atmospheric and liquid release pathways combined (person-rem)	1.5x10 ⁻⁶	1.6	3.3x10 ⁻⁸	3.7x10 ⁻³	2.3x10 ⁻⁷	2.4	6.3x10 ⁻⁷	2.8x10 ⁻⁴	1.1x10 ⁻⁵	34	1.2x10 ⁻⁵	44						
Percent of natural background ^c	8.0x10 ⁻¹⁰	8.4x10 ⁻⁴	3.6x10 ⁻¹⁰	4.0x10 ⁻⁵	2.5x10 ⁻¹⁰	2.7x10 ⁻³	2.7x10 ⁻³	5.4x10 ⁻¹⁰	2.4x10 ⁻⁷	2.9x10 ⁻⁹	9.0x10 ⁻³	4.5x10 ⁻⁹	0.017					
10-year fatal cancers	7.5x10 ⁻⁹	7.8x10 ⁻³	1.7x10 ⁻¹⁰	1.9x10 ⁻⁵	1.2x10 ⁻⁹	0.012	3.2x10 ⁻⁹	1.4x10 ⁻⁶	5.5x10 ⁻⁸	0.17	6.0x10 ⁻⁸	0.22						

Table 4.3.3.2.1.9-1. Potential Radiological Impacts to the Public During Normal Operation of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a
Annual Dose to the Average Individual Within 80 Kilometers^e												
Atmospheric and liquid release pathways combined (mrem)	2.4x10 ⁻⁹	2.6x10 ⁻³	1.1x10 ⁻⁹	1.3x10 ⁻⁴	8.6x10 ⁻¹⁰	8.9x10 ⁻³	1.8x10 ⁻⁹	8.0x10 ⁻⁷	8.6x10 ⁻⁹	0.026	1.3x10 ⁻⁸	0.049
10-year fatal cancer risk	1.2x10 ⁻¹⁴	1.3x10 ⁻⁸	5.6x10 ⁻¹⁵	6.3x10 ⁻¹⁰	4.3x10 ⁻¹⁵	4.5x10 ⁻⁸	9.0x10 ⁻¹⁵	4.0x10 ⁻¹²	4.3x10 ⁻¹⁴	1.3x10 ⁻⁷	6.7x10 ⁻¹⁴	2.5x10 ⁻⁷

^a Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9). The location of the maximally exposed individual may be different under No Action than for operation of the ceramic immobilization facility. Therefore, the impacts may not be directly additive.

^b The applicable radiological limits for an individual member of the public from total site operations are: 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 rem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

^c The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem; the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem; the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem; the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem; the population within 80 km receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem; the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem; the population within 80 km receives 266,000 person-rem.

^d For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

^e Obtained by dividing the population dose by the number of people projected to be living within 80 km (50 mi) of the site (621,000 at Hanford, 29,400 at NTS, 269,000 at INEL, 350,000 at Pantex, 1,285,000 at ORR, and 893,000 at SRS).

Source: Section M.2.

Table 4.3.3.2.1.9-2. Potential Radiological Impacts to Workers During Normal Operation of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce^a						
Average worker dose (mrem/yr) ^b	244	244	244	244	244	244
10-year risk of fatal cancer	9.8x10 ⁻⁴	9.8x10 ⁻⁴	9.8x10 ⁻⁴	9.8x10 ⁻⁴	9.8x10 ⁻⁴	9.8x10 ⁻⁴
Total dose (person-rem/yr)	110	110	110	110	110	110
10-year fatal cancers	0.44	0.44	0.44	0.44	0.44	0.44
Noninvolved Workforce^c						
Average worker dose (mrem/yr) ^b	27	5.0	30	10	2.6	32
10-year risk of fatal cancer	1.1x10 ⁻⁴	2.0x10 ⁻⁵	1.2x10 ⁻⁴	4.0x10 ⁻⁵	1.0x10 ⁻⁵	1.3x10 ⁻⁴
Total dose (person-rem/yr)	250	3.0	220	14	44	226
10-year fatal cancers	1.0	0.012	0.88	0.056	0.18	0.90
Total Site Workforce^d						
Dose (person-rem/yr)	360	113	330	124	154	336
10-year fatal cancers	1.4	0.45	1.3	0.50	0.62	1.3

^a The involved worker is a worker associated with operations of the ceramic immobilization facility.

^b The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

^c The noninvolved worker is a worker onsite but not associated with operations of the ceramic immobilization facility. The noninvolved workforce is equivalent to the No Action workforce.

^d The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

noninvolved worker would range from 2.6 mrem at the ORR site to 32 mrem at the SRS site. The annual total dose to all noninvolved workers would range from 3.0 person-rem at NTS to 250 person-rem at the Hanford site. The annual dose to the total site workforces would range from 113 person-rem at NTS to 360 person-rem at Hanford. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.3.2.1.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation resources, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public resulting from normal operation of the ceramic immobilization without radionuclides facility at each of several sites are presented in Table 4.3.3.2.1.9–3. Included is the impact due only to operation of the ceramic immobilization facility and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI ranges from 2.3×10^{-4} at the NTS site to 9.1×10^{-3} at the ORR site due to the facility operation. The cancer risk from hazardous chemicals to the MEI is zero at all sites. The HI to the onsite worker ranges from 7.2×10^{-2} at Pantex to 0.15 at ORR, and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals) at all sites.

Facility Accidents. A set of potential accidents have been postulated for a ceramic immobilization without radionuclides facility for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Tables 4.3.3.2.1.9–4 through 4.3.3.2.1.9–9 for the sites analyzed (Hanford, NTS, INEL, Pantex, ORR, and SRS). In the event that the site boundary is less than 1,000 m (3,280 ft) from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 6.3×10^{-4} at ORR for the calciner feed criticality accident scenario with a probability of 1.0×10^{-5} per year. The corresponding 10 year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 6.3×10^{-8} , 2.9×10^{-10} , and 1.3×10^{-9} , respectively. The maximum population 10-year facility lifetime risk would be 6.3×10^{-8} (that is, one fatality in over 1 million years) at ORR for the calciner feed criticality accident scenario with a probability of 1.0×10^{-5} per year. The corresponding maximum offsite individual and worker 10 year facility lifetime risks would be 2.9×10^{-10} and 1.3×10^{-9} , respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.3.2.1.9–4 through 4.3.3.2.1.9–9.

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction and operation of a new facility, DOE orders require detailed safety analyses to assure that facility designs and operation procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new ceramic immobilization facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is a possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

Table 4.3.3.2.1.9-3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Ceramic Immobilization Facility (For Borehole)—Immobilized Disposition Alternative

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b
Maximally Exposed Individual (Public)												
Hazard Index ^c	1.6x10 ⁻³	1.6x10 ⁻³	2.3x10 ⁻⁴	2.3x10 ⁻⁴	3.3x10 ⁻³	0.019	8.7x10 ⁻³	0.014	9.1x10 ⁻³	0.049	4.2x10 ⁻⁴	5.6x10 ⁻³
Cancer Risk ^d	0	0	0	0	0	3.6x10 ⁻⁶	0	1.1x10 ⁻⁸	0	0	0	1.3x10 ⁻⁷
Worker Onsite												
Hazard Index ^e	0.14	0.14	0.074	0.074	0.14	0.37	0.072	0.078	0.15	0.30	0.13	1.3
Cancer Risk ^f	0	0	0	0	0	7.7x10 ⁻⁴	0	4.5x10 ⁻⁷	0	0	0	1.9x10 ⁻⁴

^a Facility=Contribution from the proposed new facility operation only.

^b Total=Includes the contributions from the No Action and the proposed new facility operation.

^c Hazard Index for MEI=sum of individual Hazard Quotients (noncancer health effects) for MEI.

^d Cancer Risk for MEI=(emissions concentrations) x (0.286 [converts concentrations to doses]) x (Slope Factor). Where there are no known carcinogens among the hazardous chemicals emitted, therefore the calculated cancer risk value is 0.

^e Hazard Index for Workers=sum of individual Hazard Quotients (noncancer health effects) for workers.

^f Cancer Risk for workers=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (Slope Factor). Where there are no known carcinogens among the hazardous chemicals emitted, therefore the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4-41 through M.3.4-46.

Table 4.3.3.2.1.9-4. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Hanford Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c	Accident Frequency (per yr)
Earthquake	2.3x10 ⁻¹³	2.3x10 ⁻⁹	2.3x10 ⁻¹⁵	2.3x10 ⁻¹¹	1.6x10 ⁻¹¹	1.6x10 ⁻⁷	1.0x10 ⁻⁵
Glovebox fire	2.3x10 ⁻¹³	2.3x10 ⁻⁹	2.3x10 ⁻¹⁵	2.3x10 ⁻¹¹	1.6x10 ⁻¹¹	1.6x10 ⁻⁷	1.0x10 ⁻⁵
Glovebox nuclear criticality	1.4x10 ⁻¹⁰	1.4x10 ⁻⁶	1.2x10 ⁻¹²	1.2x10 ⁻⁸	1.6x10 ⁻⁹	1.6x10 ⁻⁵	1.0x10 ⁻⁵
Calciner feed tank nuclear criticality	1.4x10 ⁻⁹	1.4x10 ⁻⁵	1.2x10 ⁻¹¹	1.2x10 ⁻⁷	1.6x10 ⁻⁸	1.6x10 ⁻⁴	1.0x10 ⁻⁵
Ceramic can drop	5.7x10 ⁻¹⁶	5.7x10 ⁻¹⁴	5.7x10 ⁻¹⁸	5.7x10 ⁻¹⁶	4.1x10 ⁻¹⁴	4.1x10 ⁻¹²	1.0x10 ⁻³
Pellet container breakage	5.7x10 ⁻¹⁸	5.7x10 ⁻¹⁶	5.7x10 ⁻²⁰	5.7x10 ⁻¹⁸	4.1x10 ⁻¹⁶	4.1x10 ⁻¹⁴	1.0x10 ⁻³
Dissolver spill	1.4x10 ⁻¹⁵	2.7x10 ⁻¹⁵	1.4x10 ⁻¹⁷	2.7x10 ⁻¹⁷	1.0x10 ⁻¹³	2.0x10 ⁻¹³	0.05
Calciner feed spill	4.0x10 ⁻¹⁵	7.9x10 ⁻¹⁵	4.0x10 ⁻¹⁷	7.9x10 ⁻¹⁷	2.9x10 ⁻¹³	5.8x10 ⁻¹³	0.05
Calciner product spill	1.0x10 ⁻¹²	2.0x10 ⁻¹²	1.0x10 ⁻¹⁴	2.0x10 ⁻¹⁴	7.2x10 ⁻¹¹	1.4x10 ⁻¹⁰	0.05
Sintering furnace explosion	3.4x10 ⁻¹³	3.4x10 ⁻⁸	3.4x10 ⁻¹⁵	3.4x10 ⁻¹⁰	2.5x10 ⁻¹¹	2.5x10 ⁻⁶	1.0x10 ⁻⁶
Uncontrolled chemical reaction	1.6x10 ⁻¹⁴	1.6x10 ⁻⁹	1.6x10 ⁻¹⁶	1.6x10 ⁻¹¹	1.2x10 ⁻¹²	1.2x10 ⁻⁷	1.0x10 ⁻⁶
Nuclear criticality	1.4x10 ⁻¹¹	1.4x10 ⁻⁶	1.2x10 ⁻¹³	1.2x10 ⁻⁸	1.6x10 ⁻¹⁰	1.6x10 ⁻⁵	1.0x10 ⁻⁶
Expected risk ^d	1.5x10 ⁻⁹	—	1.3x10 ⁻¹¹	—	1.8x10 ⁻⁸	—	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1-3 and M.5.3.7.1-4 and the MACCS computer code.

Table 4.3.3.2.1.9-5. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Nevada Test Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c
Earthquake	1.6x10 ⁻¹³	1.6x10 ⁻⁹	3.6x10 ⁻¹⁵	3.6x10 ⁻¹¹	3.7x10 ⁻¹³	3.7x10 ⁻⁹
Glovebox fire	1.6x10 ⁻¹³	1.6x10 ⁻⁹	3.6x10 ⁻¹⁵	3.6x10 ⁻¹¹	3.7x10 ⁻¹³	3.7x10 ⁻⁹
Glovebox nuclear criticality	1.0x10 ⁻¹⁰	1.0x10 ⁻⁶	2.3x10 ⁻¹²	2.3x10 ⁻⁸	3.3x10 ⁻¹¹	3.3x10 ⁻⁷
Calciner feed tank nuclear criticality	1.0x10 ⁻⁹	1.0x10 ⁻⁵	2.3x10 ⁻¹¹	2.3x10 ⁻⁷	3.3x10 ⁻¹⁰	3.3x10 ⁻⁶
Ceramic can drop	3.9x10 ⁻¹⁶	3.9x10 ⁻¹⁴	9.0x10 ⁻¹⁸	9.0x10 ⁻¹⁶	9.3x10 ⁻¹⁶	3.3x10 ⁻¹⁴
Pellet container breakage	3.9x10 ⁻¹⁸	3.9x10 ⁻¹⁶	9.0x10 ⁻²⁰	9.0x10 ⁻¹⁸	9.3x10 ⁻¹⁸	9.3x10 ⁻¹⁶
Dissolver spill	9.3x10 ⁻¹⁶	1.9x10 ⁻¹⁵	2.2x10 ⁻¹⁷	4.3x10 ⁻¹⁷	2.2x10 ⁻¹⁵	4.5x10 ⁻¹⁵
Calciner feed spill	2.7x10 ⁻¹⁵	5.4x10 ⁻¹⁵	6.3x10 ⁻¹⁷	1.3x10 ⁻¹⁶	6.5x10 ⁻¹⁵	1.3x10 ⁻¹⁴
Calciner product spill	6.8x10 ⁻¹³	1.4x10 ⁻¹²	1.6x10 ⁻¹⁴	3.1x10 ⁻¹⁴	1.6x10 ⁻¹²	3.3x10 ⁻¹²
Sintering furnace explosion	2.3x10 ⁻¹³	2.3x10 ⁻⁸	5.4x10 ⁻¹⁵	5.4x10 ⁻¹⁰	5.6x10 ⁻¹³	5.6x10 ⁻⁸
Uncontrolled chemical reaction	1.1x10 ⁻¹⁴	1.1x10 ⁻⁹	2.5x10 ⁻¹⁶	2.5x10 ⁻¹¹	2.6x10 ⁻¹⁴	2.6x10 ⁻⁹
Nuclear criticality	1.0x10 ⁻¹¹	1.0x10 ⁻⁶	2.3x10 ⁻¹³	2.3x10 ⁻⁸	3.3x10 ⁻¹²	3.3x10 ⁻⁷
Expected risk ^d	1.1x10 ⁻⁹	—	2.5x10 ⁻¹¹	—	3.6x10 ⁻¹⁰	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1-3 and M.5.3.7.1-4 and the MACCS computer code.

Table 4.3.3.2.1.9-6. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Idaho National Engineering Laboratory

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c	Accident Frequency (per yr)
Earthquake	2.1x10 ⁻¹³	2.1x10 ⁻⁹	2.3x10 ⁻¹⁵	2.3x10 ⁻¹¹	4.9x10 ⁻¹²	4.9x10 ⁻⁸	1.0x10 ⁻⁵
Glovebox fire	2.1x10 ⁻¹³	2.1x10 ⁻⁹	2.3x10 ⁻¹⁵	2.3x10 ⁻¹¹	4.9x10 ⁻¹²	4.9x10 ⁻⁸	1.0x10 ⁻⁵
Glovebox nuclear criticality	1.4x10 ⁻¹⁰	1.4x10 ⁻⁶	3.5x10 ⁻¹²	1.3x10 ⁻⁸	4.3x10 ⁻¹⁰	4.3x10 ⁻⁶	1.0x10 ⁻⁵
Calcliner feed tank nuclear criticality	1.4x10 ⁻⁹	1.4x10 ⁻⁵	1.3x10 ⁻¹¹	1.3x10 ⁻⁷	4.3x10 ⁻⁹	4.3x10 ⁻⁵	1.0x10 ⁻⁵
Ceramic can drop	5.3x10 ⁻¹⁶	5.3x10 ⁻¹⁴	5.7x10 ⁻¹⁸	5.7x10 ⁻¹⁶	1.2x10 ⁻¹⁴	1.2x10 ⁻¹²	1.0x10 ⁻³
Pellet container breakage	5.3x10 ⁻¹⁸	5.3x10 ⁻¹⁶	5.7x10 ⁻²⁰	5.7x10 ⁻¹⁸	1.2x10 ⁻¹⁶	1.2x10 ⁻¹⁴	1.0x10 ⁻³
Dissolver spill	1.3x10 ⁻¹⁵	2.5x10 ⁻¹⁵	1.4x10 ⁻¹⁷	2.8x10 ⁻¹⁷	3.0x10 ⁻¹⁴	5.9x10 ⁻¹⁴	0.05
Calcliner feed spill	3.7x10 ⁻¹⁵	7.4x10 ⁻¹⁵	4.0x10 ⁻¹⁷	8.0x10 ⁻¹⁷	8.7x10 ⁻¹⁴	1.7x10 ⁻¹³	0.05
Calcliner product spill	9.3x10 ⁻¹³	1.9x10 ⁻¹²	1.0x10 ⁻¹⁴	2.0x10 ⁻¹⁴	2.2x10 ⁻¹¹	4.3x10 ⁻¹¹	0.05
Sintering furnace explosion	3.2x10 ⁻¹³	3.2x10 ⁻⁸	3.4x10 ⁻¹⁵	3.4x10 ⁻¹⁰	7.4x10 ⁻¹²	7.4x10 ⁻⁷	1.0x10 ⁻⁶
Uncontrolled chemical reaction	1.5x10 ⁻¹⁴	1.5x10 ⁻⁹	1.6x10 ⁻¹⁶	1.6x10 ⁻¹¹	3.5x10 ⁻¹³	3.5x10 ⁻⁸	1.0x10 ⁻⁶
Nuclear criticality	1.4x10 ⁻¹¹	1.4x10 ⁻⁶	1.3x10 ⁻¹³	1.3x10 ⁻⁸	4.3x10 ⁻¹¹	4.3x10 ⁻⁶	1.0x10 ⁻⁶
Expected risk ^d	1.5x10 ⁻⁹	—	1.5x10 ⁻¹¹	—	4.8x10 ⁻⁹	—	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1-3 and M.5.3.7.1-4 and the MACCS computer code.

Table 4.3.3.2.1.9-7. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Pantex Plant

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c Accident Frequency (per yr)
Earthquake	9.1×10^{-14}	9.1×10^{-10}	2.6×10^{-14}	2.6×10^{-10}	5.6×10^{-12}	5.6×10^{-8} 1.0×10^{-5}
Glovebox fire	9.1×10^{-14}	9.1×10^{-10}	2.6×10^{-14}	2.6×10^{-10}	5.6×10^{-12}	5.6×10^{-8} 1.0×10^{-5}
Glovebox nuclear criticality	6.2×10^{-11}	6.2×10^{-7}	2.2×10^{-11}	2.2×10^{-7}	9.5×10^{-10}	9.5×10^{-6} 1.0×10^{-5}
Calciner feed tank nuclear criticality	6.2×10^{-10}	6.2×10^{-6}	2.2×10^{-10}	2.2×10^{-6}	9.5×10^{-9}	9.5×10^{-5} 1.0×10^{-5}
Ceramic can drop	2.3×10^{-16}	2.3×10^{-14}	6.6×10^{-17}	6.6×10^{-15}	1.4×10^{-14}	1.4×10^{-12} 1.0×10^{-3}
Pellet container breakage	2.3×10^{-18}	2.3×10^{-16}	6.6×10^{-19}	6.6×10^{-17}	1.4×10^{-16}	1.4×10^{-14} 1.0×10^{-3}
Dissolver spill	5.5×10^{-16}	1.1×10^{-15}	1.6×10^{-16}	3.2×10^{-16}	3.4×10^{-14}	6.7×10^{-14} 0.05
Calciner feed spill	1.6×10^{-15}	3.2×10^{-15}	4.6×10^{-16}	9.2×10^{-16}	9.8×10^{-14}	2.0×10^{-13} 0.05
Calciner product spill	4.0×10^{-13}	8.0×10^{-13}	1.2×10^{-13}	2.3×10^{-13}	2.5×10^{-11}	4.9×10^{-11} 0.05
Sintering furnace explosion	1.4×10^{-13}	1.4×10^{-8}	4.0×10^{-14}	4.0×10^{-9}	8.5×10^{-12}	8.5×10^{-7} 1.0×10^{-6}
Uncontrolled chemical reaction	6.4×10^{-15}	6.4×10^{-10}	1.9×10^{-15}	1.9×10^{-10}	3.9×10^{-13}	3.9×10^{-8} 1.0×10^{-6}
Nuclear criticality	6.2×10^{-12}	6.2×10^{-7}	2.2×10^{-12}	2.2×10^{-7}	9.5×10^{-11}	9.5×10^{-6} 1.0×10^{-6}
Expected risk ^d	6.9×10^{-10}	—	2.4×10^{-10}	—	1.1×10^{-8}	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1-3 and M.5.3.7.1-4 and the MACCS computer code.

Table 4.3.3.2.1.9-8. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts at Oak Ridge Reservation

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c Accident Frequency (per yr)
Earthquake	2.1×10^{-13}	2.1×10^{-9}	4.6×10^{-14}	4.6×10^{-10}	4.0×10^{-11}	4.0×10^{-7} 1.0×10^{-5}
Glovebox fire	2.1×10^{-13}	2.1×10^{-9}	4.6×10^{-14}	4.6×10^{-10}	4.0×10^{-11}	4.0×10^{-7} 1.0×10^{-5}
Glovebox nuclear criticality	1.3×10^{-10}	1.3×10^{-6}	2.9×10^{-11}	2.9×10^{-7}	6.3×10^{-9}	6.3×10^{-5} 1.0×10^{-5}
Calciner feed tank nuclear criticality	1.3×10^{-9}	1.3×10^{-5}	2.9×10^{-10}	2.9×10^{-6}	6.3×10^{-8}	6.3×10^{-4} 1.0×10^{-5}
Ceramic can drop	5.3×10^{-16}	5.3×10^{-14}	1.2×10^{-16}	1.2×10^{-14}	1.0×10^{-13}	1.0×10^{-11} 1.0×10^{-3}
Pellet container breakage	5.3×10^{-18}	5.3×10^{-16}	1.2×10^{-18}	1.2×10^{-16}	1.0×10^{-15}	1.0×10^{-13} 1.0×10^{-3}
Dissolver spill	1.3×10^{-15}	2.5×10^{-15}	2.8×10^{-16}	5.5×10^{-16}	2.4×10^{-13}	4.8×10^{-13} 0.05
Calciner feed spill	3.7×10^{-15}	7.3×10^{-15}	8.1×10^{-16}	1.6×10^{-15}	7.0×10^{-13}	1.4×10^{-12} 0.05
Calciner product spill	9.2×10^{-13}	1.8×10^{-12}	2.0×10^{-13}	4.0×10^{-13}	1.7×10^{-10}	3.5×10^{-10} 0.05
Sintering furnace explosion	3.2×10^{-13}	3.2×10^{-8}	6.9×10^{-14}	6.9×10^{-9}	6.0×10^{-11}	6.0×10^{-6} 1.0×10^{-6}
Uncontrolled chemical reaction	1.5×10^{-14}	1.5×10^{-9}	3.2×10^{-15}	3.2×10^{-10}	2.8×10^{-12}	2.8×10^{-7} 1.0×10^{-6}
Nuclear criticality	1.3×10^{-11}	1.3×10^{-6}	2.9×10^{-12}	2.9×10^{-7}	6.3×10^{-10}	6.3×10^{-5} 1.0×10^{-6}
Expected risk ^d	1.4×10^{-9}	—	3.2×10^{-10}	—	7.0×10^{-8}	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1-3 and M.5.3.7.1-4 and the MACCS computer code.

Table 4.3.3.2.1.9-9. Ceramic Immobilization Facility (For Borehole) for Immobilized Disposition Alternative—Accident Impacts
at Savannah River Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality (per 10 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities (per 10 yr) ^a	Number of Cancer Fatalities ^c
Earthquake	1.5x10 ⁻¹³	1.5x10 ⁻⁹	3.6x10 ⁻¹⁵	3.6x10 ⁻¹¹	1.8x10 ⁻¹¹	1.8x10 ⁻⁷
Glovebox fire	1.5x10 ⁻¹³	1.5x10 ⁻⁹	3.6x10 ⁻¹⁵	3.6x10 ⁻¹¹	1.8x10 ⁻¹¹	1.8x10 ⁻⁷
Glovebox nuclear criticality	9.1x10 ⁻¹¹	9.1x10 ⁻⁷	2.0x10 ⁻¹²	2.0x10 ⁻⁸	2.0x10 ⁻⁹	2.0x10 ⁻⁵
Calciner feed tank nuclear criticality	9.1x10 ⁻¹⁰	9.1x10 ⁻⁶	2.0x10 ⁻¹¹	2.0x10 ⁻⁷	2.0x10 ⁻⁸	2.0x10 ⁻⁴
Ceramic can drop	3.7x10 ⁻¹⁶	3.7x10 ⁻¹⁴	9.1x10 ⁻¹⁸	9.1x10 ⁻¹⁶	4.4x10 ⁻¹⁴	4.4x10 ⁻¹²
Pellet container breakage	3.7x10 ⁻¹⁸	3.7x10 ⁻¹⁶	9.1x10 ⁻²⁰	9.1x10 ⁻¹⁸	4.4x10 ⁻¹⁶	4.4x10 ⁻¹⁴
Dissolver spill	8.9x10 ⁻¹⁶	1.8x10 ⁻¹⁵	2.2x10 ⁻¹⁷	4.4x10 ⁻¹⁷	1.1x10 ⁻¹³	2.1x10 ⁻¹³
Calciner feed spill	2.6x10 ⁻¹⁵	5.2x10 ⁻¹⁵	6.4x10 ⁻¹⁷	1.3x10 ⁻¹⁶	3.1x10 ⁻¹³	6.2x10 ⁻¹³
Calciner product spill	6.5x10 ⁻¹³	1.3x10 ⁻¹²	1.6x10 ⁻¹⁴	3.2x10 ⁻¹⁴	7.8x10 ⁻¹¹	1.6x10 ⁻¹⁰
Sintering furnace explosion	2.2x10 ⁻¹³	2.2x10 ⁻⁸	5.5x10 ⁻¹⁵	5.5x10 ⁻¹⁰	2.7x10 ⁻¹¹	2.7x10 ⁻⁶
Uncontrolled chemical reaction	1.0x10 ⁻¹⁴	1.0x10 ⁻⁹	2.6x10 ⁻¹⁶	2.6x10 ⁻¹¹	1.2x10 ⁻¹²	1.2x10 ⁻⁷
Nuclear criticality	9.1x10 ⁻¹²	9.1x10 ⁻⁷	2.0x10 ⁻¹³	2.0x10 ⁻⁸	2.0x10 ⁻¹⁰	2.0x10 ⁻⁵
Expected risk ^d	1.0x10 ⁻⁹	—	2.2x10 ⁻¹¹	—	2.3x10 ⁻⁸	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km is exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Source: Calculated using the source terms in Tables M.5.3.7.1-3 and M.5.3.7.1-4 and the MACCS computer code.

| An indication of the magnitude of the impacts of an aircraft crash into a ceramic immobilization facility is given by the earthquake scenario. The earthquake and aircraft scenarios are similar in that they both result in major structural damage and the release of plutonium directly to the environment. They differ in that an earthquake induced fire is based on limited combustible materials while the aircraft crash has the potential for a major fuel-related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive fatal injuries.

| [Text deleted.]

4.3.3.2.1.10 Waste Management

This section summarizes the waste management impacts for the construction and operation of a ceramic immobilization facility. There is no spent nuclear fuel or HLW associated with the operation of the ceramic immobilization facility; however, the facility does generate as its output product a stabilized coated ceramic pellet form that would require interim storage with final disposal at the deep borehole complex whose impacts are outlined in Section 4.3.3.2.2.10. The ceramic immobilization facility would provide the necessary storage of the immobilized Pu in ceramic form until its disposal in the deep borehole complex. Table 4.3.3.2.1.10-1 provides the estimated operational waste volumes projected to be generated as a result of the ceramic immobilization facility at the sites analyzed. Facilities that would support the ceramic immobilization facility would treat and package all generated waste into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated, and depending on the type of waste disposed of, onsite or at regionalized or centralized DOE sites. For the purposes of analysis only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the ceramic immobilization facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.3. A detailed description of the waste management activities that would be required to support the ceramic immobilization facility can also be found in Section E.3.3.3.

Construction and operation of a ceramic immobilization facility would impact existing waste management activities at each of the sites analyzed, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

The conceptual design of the ceramic immobilization facility using coated pellets includes a radioactive liquid waste treatment facility which would be required to treat the 110 m³ (30,000 gal) of liquid TRU waste. Approximately 150 m³ (200 yd³) of TRU waste consisting of job-control waste (protective clothing and radiological survey waste), HEPA filters, resins, and solidified sludge from liquid TRU waste treatment would require treatment and repackaging to meet the current planning-basis WIPP WAC or alternative treatment level. Hanford, INEL, and SRS have existing and planned TRU waste facilities that could be utilized. Due to their limited capability to process, package, and store TRU waste, a radwaste facility would need to be constructed as part of the ceramic immobilization facility if sited at ORR, Pantex, and NTS. A small quantity 1.5 m³ (2 yd³) of mixed TRU waste would require processing and packaging to meet the current planning-basis WIPP WAC or alternative treatment level. Mixed TRU waste would be generated if a TRU waste stream became contaminated with a hazardous waste constituent. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), 18 additional truck shipments per year, or if applicable, 9 regular train shipments per year or 3 dedicated train shipments per year would be required.

The radioactive liquid waste treatment facility would also treat the 10 m³ (2,700 gal) of liquid LLW from infrequent container decontamination, laboratory solutions, and scrubber solutions from stacks and exhaust systems. Following treatment and volume reduction, approximately 15 m³ (20 yd³) of LLW from solidified liquid LLW, protective clothing, soil, and small equipment would require disposal. Except for disposal, all of

**Table 4.3.3.2.1.10-1. Estimated Annual Generated Waste Volumes for Ceramic Immobilization Facility (For Borehole)—
Immobilized Disposition Alternative^a**

Category	New Facility (m ³)	Hanford	NTS	INEL	Pantex	ORR	SRS
		No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)
Transuranic							
Liquid	110 ^b	None	None	None	None	None	None
Solid	150	271	None	3.5	None	119	338
Mixed Transuranic							
Liquid	0	None	None	None	None	None	None
Solid	1.5	98	None	Included in TRU	None	None	Included in TRU
Low-level							
Liquid	10 ^b	None	Dependent on restoration activities	None	8	2,970	74,000
Solid	23	3,390	15,000	7,200	32	7,320	16,400
Mixed Low-level							
Liquid	0	3,760	None	4	4	87,600	1,330
Solid	0.3	1,505	50	170	46	432	7,700
Hazardous							
Liquid	45	Included in solid	Included in solid	Included in solid	2	6,460	1,260
Solid	23	560	212	1,200	31	26	15,100
Nonhazardous (Sanitary)							
Liquid	43,000	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000
Solid	910	5,107	2,120	52,000	339	53,100	61,200
Nonhazardous (Other)							
Liquid	186,900	Included in sanitary	Included in sanitary	None	Included in sanitary	650,000	Included in sanitary
Solid	15 ^c	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary

^a The No Action volumes are from Tables 4.2.1.10-1, 4.2.2.10-1, 4.2.3.10-1, 4.2.4.10-1, 4.2.5.10-1, and 4.2.6.10-1. Incremental waste generation volumes for the ceramic immobilization facility were derived from Table E.3.3.3-1. Waste effluent volumes (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in Table E.3.3.3-1.

^b Liquid TRU and LLW would be treated and solidified prior to disposal.

^c Recyclable wastes.

the sites analyzed have existing or planned facilities that could manage the small quantities of LLW. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.004 ha/yr (0.01 acres/yr) at Hanford and ORR, 0.003 ha/yr (0.006 acres/yr) at NTS and INEL, and 0.002 ha/yr (0.004 acres/yr) at SRS. With no onsite LLW disposal capability, Pantex would require one additional LLW shipment per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

A small quantity (0.3 m^3 [0.4 yd^3]) of solid mixed LLW consisting of contaminated solvent rags and equipment that have been contaminated with both radioactive and hazardous constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the Tri-Party Agreement for Hanford and the respective site treatment plan that was developed to comply with the *Federal Facility Compliance Act* for the remainder of the sites analyzed.

An estimated 45 m^3 (12,000 gal) of liquid and 23 m^3 (30 yd^3) of solid hazardous wastes would be generated. Hazardous waste would consist primarily of analytical solutions and solvent rags contaminated with methylene chloride, acetonitrile, and acetone. Other hazardous waste would include paint solvents, various laboratory chemicals, and organic waste from nonradioactive testing. Hazardous waste would be stored in RCRA-permitted facilities until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

Approximately $43,000 \text{ m}^3$ (11,500,000 gal) of liquid nonhazardous sanitary and industrial wastewater and $186,900 \text{ m}^3$ (49,500,000 gal) of steam plant blowdown, process wastewater, and estimated stormwater runoff would require treatment in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems may be required. The 910 m^3 ($1,200 \text{ yd}^3$) of solid nonhazardous waste such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

4.3.3.2.2 *Deep Borehole Complex*

The environmental impacts described in the following sections are based on the analysis of the deep borehole complex for the Immobilization Disposition Alternative as described in Section 2.4.3.2.2. Environmental impacts for this facility are described in the context of a generic range of conditions that could exist at potential locations.

4.3.3.2.2.1 *Land Resources*

The deep borehole complex would disturb 63 ha (156 acres) of land during construction, of which 57 ha (141 acres) would be used during operation. The facility would be sited within a 1.6-km (1-mi) buffer zone for a total land requirement of 2,041 ha (5,044 acres). However, the potential site could range up to 20,000 ha (49,420 acres) of land area. If the borehole site were located on privately owned land, it would likely require the low to middle range of land area. If the site were located on publicly owned land (Federal, State, or local), the borehole could be part of a much larger site and could require the upper range of land area. Because no site has been identified for analysis, impacts to land use and visual resources cannot be determined at this time. If this alternative is selected, a siting study would be conducted in support of NEPA tiered documentation.

4.3.3.2.2.3 Air Quality and Noise

Construction and operation of the deep borehole complex would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal standards. Impacts for radiological airborne emissions are discussed in Section 4.3.3.2.2.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts for this facility are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants for the generic sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM₁₀ and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected the site will continue to comply with applicable Federal and State ambient air quality standards during construction.

Emission rates for operation of the deep borehole complex are presented in Table F.1.3–8. Air pollutant emissions sources associated with operations include the following:

- Operation of boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- [Text deleted.]

During operation, impacts with respect to the concentrations of criteria and toxic/hazardous air pollutants are expected to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for operation of this facility plus the No Action concentrations are presented in Table 4.3.3.2.2.3–1.

NOISE

The location of the facilities associated with the deep borehole complex relative to the site boundary and sensitive receptors was examined to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Non-traffic noise sources associated with operation of these facilities include ventilation systems, cooling systems, material handling equipment, drilling rigs, pumps, and generators. These noise sources are assumed to

Table 4.3.3.2.2.3–1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Deep Borehole Complex and No Action Alternative—Immobilized Disposition Alternative

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ^a ($\mu\text{g}/\text{m}^3$)	Generic Site ($\mu\text{g}/\text{m}^3$) ^b
Criteria Pollutants			
Carbon monoxide	8-hour	10,000	72.20
	1-hour	40,000	103.10
Lead	Calendar Quarter	1.5	^c
Nitrogen dioxide	Annual	100	28.78
Ozone	1-hour	235	^d
Particulate matter less than or equal to 10 microns in diameter	Annual	50	10.41
	24-hour	150	41.64
Sulfur dioxide	Annual	80	2.57
	24-hour	365	10.28
	3-hour	1,300	23.13
Hazardous and Other Toxic Compounds^e			
[Text deleted.]			

^a The Federal standards are presented.

^b The concentration represents the alternative contribution only. No Action concentrations at a generic site cannot be determined since there is a range of possible pollutants and conditions that could be found at a potential site.

^c No sources of this pollutant have been identified.

^d Ozone, as a criteria pollutant, is not directly emitted or monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

^e Emissions of unspecified hydrocarbons were not modeled.

Note: Concentrations are based on site contribution and do not include the contribution from non-facility sources.

Source: 40 CFR 50; LLNL 1996h.

be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. It is assumed that due to the size of the sites, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts, such as disturbance of wildlife.

4.3.3.2.2.4 *Water Resources*

Water usage and wastewater generated differ slightly between the two deep borehole alternatives. However, these differences should not cause any additional impacts to those described in Section 4.3.3.1.4. Water resource data for immobilization to a deep borehole facility are slightly less than the impacts shown in Table 4.3.3.1.4–1.

In general, ceramic immobilization would aid in preventing/delaying the emplaced materials from interacting with the subsurface environment (that is, being dissolved by the brine at depth). These interactions were described in Section 4.3.3.1.4.

[Text deleted.]

4.3.3.2.2.5 *Geology and Soils*

The deep borehole complex area disturbed during construction activities for this alternative would be 63 ha (156 acres). The deep borehole complex represents an irreversible commitment because wastes in below-ground area could not be completely removed, nor could the site be feasibly used for any other purposes following closure of the facility. This land would be perpetually unusable because the substrata would not be suitable for potentially intrusive facilities such as mining, utilities, or building foundations. Because no site has been identified for analysis, impacts to geologic and soil resources cannot be determined at this time.

The identification and acceptance of a site location would require extensive site characterization to ensure that the primary objective of the deep borehole complex, isolation from the biosphere, would be met. A site study would be conducted in support of the tiered NEPA documentation.

4.3.3.2.2.6 *Biological Resources*

Potential impacts to biological resources described for direct disposition in a deep borehole complex described in Section 4.3.3.1.6 would also apply to the disposal of immobilized Pu in a deep borehole complex. Both borehole complexes would require the same amount of land and would be subject to the same siting criteria.

4.3.3.2.7 Cultural and Paleontological Resources

The construction of the deep borehole complex would disturb approximately 63 ha (156 acres) of land. The operational land requirement is 2,041 ha (5,044 acres), which includes a 1.6-km (1-mile) buffer zone. The actual facility requires 57 ha (141 acres) during operation. In addition, approximately 1.6 km (1 mi) each of road or railway would also be constructed. No specific site has been proposed for this alternative. Impacts to cultural and paleontological resources would be addressed in tiered NEPA documents as appropriate. A siting study would be conducted in support of tiered NEPA documentation.

Prehistoric and historic resources that may be NRHP-eligible would be identified through additional surveys. Specific concerns about the presence, type, and location of Native American resources would be addressed through consultation with the potentially affected tribes in accordance with the NHPA, the *Native American Graves Protection and Repatriation Act*, and the *American Indian Religious Freedom Act*. Therefore, it is not possible to determine potential effects on cultural and paleontological resources.

4.3.3.2.2.8 *Socioeconomics*

The deep borehole complex for the Immobilized Disposition Alternative is similar to the deep borehole complex for the Direct Disposition Alternative. The only difference between the two alternatives with respect to socioeconomic effects is in the number of construction and operation workers required. The Immobilization Disposition Alternative would require 810 construction and 280 operation workers versus 870 construction and 342 operation workers needed for the Direct Disposition Alternative. Thus, the socioeconomic effects for this alternative would be slightly less than the Direct Disposition Alternative because fewer workers would be required and any population growth resulting from in-migrating workers and associated effects on the ROI would be smaller. For a detailed discussion of the socioeconomic effects of constructing and operating a deep borehole complex, see Section 4.3.3.1.8.

4.3.3.2.2.9 Public and Occupational Health and Safety

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with disposal of immobilized Pu in a deep borehole complex. The section first describes the impacts from normal operation at the generic site, followed by a description of impacts from facility accidents.

For the public, the analysis includes an annual dose and cumulative risk to the maximally exposed individual, population, and average individual within 80 km (50 mi). For workers, the analysis includes an annual dose and cumulative risk to an average individual worker and total involved and noninvolved workforce. The health effects were derived from data for representative DOE sites described in Sections 3.2 through 3.7. Data for the representative DOE sites were used to allow quantification of impacts, but do not necessarily capture the entire range of potential deep borehole complex sites. This approach to the radiological risk assessment differs from the analysis of other resources, which are analyzed based on a generic deep borehole site. Because the analysis of radiological dose impacts requires site-specific conditions, such as meteorology and surrounding populations, a generic site analysis would not be possible because of the infinite number of site-specific conditions.

Summaries of the radiological impacts to the public and to workers associated with normal operation of the deep borehole complex during the assumed 10-year campaign time are presented in Tables 4.3.3.2.2.9–1 and 4.3.3.2.2.9–2, respectively. [Text deleted.] Impacts from hazardous chemicals to these same groups are given in Table 4.3.3.2.2.9–3. Summaries of impacts associated with postulated accidents are given in Table 4.3.3.2.2.9–4. Detailed results are presented in Section M.

Normal Operation. There would be no radiological releases associated with the construction of a deep borehole complex. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the deep borehole complex are presented in Table 4.3.3.2.2.9–1. The impacts from all site operations, including the deep borehole complex, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the maximally exposed member of the public from annual operation of the deep borehole complex would range from 3.4×10^{-9} to 1.2×10^{-7} mrem. From 10 years of operation, the risk of fatal cancer to this individual would range from 1.7×10^{-14} to 6.0×10^{-13} . The impacts to the average individual would be less. As a result of annual operations, the population dose would range from 6.6×10^{-9} to 2.2×10^{-6} person-rem. The number of fatal cancers in the population from 10 years of operation would range from 3.3×10^{-11} to 1.1×10^{-8} .

The upper bounding dose of 3.2 mrem to the maximally exposed member of the public from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. The risk of fatal cancer to this individual from 10 years of operation would be 1.6×10^{-5} . The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are as low as reasonably conceivable. As a result of annual total site operations, the upper bound population dose would be within the limit proposed in 10 CFR 834, and would be 44 person-rem. The number of fatal cancers in this population from 10 years of operation would be 0.22.

Table 4.3.3.2.2.9-1. Potential Radiological Impacts to the Public During Normal Operation of the Deep Borehole Complex—Immobilized Disposition Alternative

Receptor	Generic Site ^a	
	Deep Borehole Complex	Total Site
Annual Dose to the Maximally Exposed Individual Member of the Public^b		
Atmospheric release pathway (mrem)	3.4×10^{-9} to 1.2×10^{-7}	6.1×10^{-5} to 1.5
Drinking water pathway (mrem)	0	0 to 0.10
Total liquid release pathway (mrem)	0	0 to 1.7
Atmospheric and liquid release pathways combined (mrem)	3.4×10^{-9} to 1.2×10^{-7}	6.1×10^{-5} to 3.2
Percent of natural background ^c	1.1×10^{-9} to 4.1×10^{-8}	1.8×10^{-5} to 1.1
10-year fatal cancer risk	1.7×10^{-14} to 6.0×10^{-13}	3.1×10^{-10} to 1.6×10^{-5}
Annual Population Dose Within 80 Kilometers^d		
Atmospheric release pathways (mrem)	6.6×10^{-9} to 2.2×10^{-6}	2.8×10^{-4} to 40
Total liquid release pathways (mrem)	0	0 to 4.7
Atmospheric and liquid release pathways combined (mrem)	6.6×10^{-9} to 2.2×10^{-6}	2.8×10^{-4} to 44
Percent of natural background ^c	7.2×10^{-11} to 8.3×10^{-10}	2.4×10^{-7} to 0.017
10-year fatal cancers	3.3×10^{-11} to 1.1×10^{-8}	1.4×10^{-6} to 0.22
Annual Dose to the Average Individual Within 80 Kilometers^e		
Atmospheric and liquid release pathways combined (mrem)	2.2×10^{-10} to 2.5×10^{-9}	8.0×10^{-7} to 0.049
10-year fatal cancer risk	1.1×10^{-15} to 1.2×10^{-14}	4.0×10^{-12} to 2.5×10^{-7}

^a Ranges for the "Deep Borehole Complex" and "Total Site" doses may not necessarily reflect the same respective sites. The total site values are applicable only if the deep borehole complex were located on DOE sites and would not apply if generic non-DOE sites were selected.

^b The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year for the air pathways as required by NESHAPS (40 CFR 61, Subpart H) under the CAA, 4 mrem per year from the drinking water pathway as required by the SDWA, and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

^c Annual natural background radiation levels: the average individual receives a dose that could range from 295 to 338 mrem; the population within 80 km receives a dose that could range from 9,190 to 379,000 person-rem.

^d For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

^e Obtained by dividing the population dose at a site by the number of people projected to be living within 80 km of that site. The number of people ranges from 29,400 to 1,285,000.

Source: HNUS 1996a. Ranges are based on impacts from the following representative DOE sites: Hanford, NTS, INEL, Pantex, ORR, and SRS.

Doses to onsite workers from normal operations are given in Table 4.3.3.2.2.9–2. Included are involved workers directly associated with the deep borehole complex, workers who are not involved with the deep borehole complex, and the entire workforce at the site. All doses fall within regulatory limits.

Table 4.3.3.2.2.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Deep Borehole Complex—Immobilized Disposition Alternative

Receptor	Generic Site
Involved Workforce^a	
Average worker dose (mrem/yr) ^b	13
10-year risk of fatal cancer	5.2×10^{-5}
Total dose (person rem/yr)	2.2
10-year fatal cancers	8.8×10^{-3}
Noninvolved Workforce^c	
Average worker dose (mrem/yr) ^b	2.6 to 32
10-year risk of fatal cancer	1.0×10^{-5} to 1.3×10^{-4}
Total dose (person rem/yr)	3.0 to 250
10-year fatal cancers	0.012 to 1.0
Total Site Workforce^d	
Dose (person-rem/yr)	5.2 to 252
10-year fatal cancers	0.021 to 1.0

^a The involved worker is a worker associated with operations of the deep borehole complex. The estimated number of badged involved workers is 168.

^b The radiological limit for an individual worker is 5,000 mrem/yr (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem/yr (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

^c The noninvolved worker is a worker on-site but not associated with operations of the deep borehole complex. The ranges for the noninvolved workers are based on No Action values for Hanford, NTS, INEL, Pantex, ORR, and SRS. Noninvolved worker doses are shown for comparison purposes only and would not apply if the deep borehole complex were located at a separate dedicated site. The Noninvolved Workforce is equivalent to the No Action workforce.

^d The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact. [Text deleted.]

Source: LLNL 1996a for involved workers. For the noninvolved workers see Sections 4.2.1.9, 4.2.2.9, 4.2.3.9, 4.2.4.9, 4.2.5.9, and 4.2.6.9, respectively.

The annual dose to the average deep borehole complex worker would be 13 mrem; the entire deep borehole complex workforce would receive 2.2 person-rem annually. The annual dose to the average noninvolved worker would range from 2.6 to 32 mrem, depending on the borehole site (if an existing DOE site were chosen), and the annual total dose to all noninvolved workers would range from 3.0 to 250 person-rem. The annual dose to the total site workforces would range from 5.2 to 252 person-rem. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.3.2.2.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public resulting from normal operation of the deep borehole complex at the generic site are presented in Table 4.3.3.2.2.9–3. Included is the impact due only to operation of the deep borehole complex and the sites's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

Table 4.3.3.2.2.9–3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Deep Borehole Complex—Immobilized Disposition Alternative

Receptor	Deep Borehole Complex Generic Site	
	Facility ^a	Total Site ^b
Maximally Exposed Individual (Public)		
Hazard Index ^c	1.2×10^{-3}	1.2×10^{-3}
Cancer risk ^d	0	0
Worker Onsite		
Hazard Index ^e	0.28	0.28
Cancer risk ^f	0	0

^a Facility=Contribution from the proposed new facility operation only.

^b Total=Includes the contributions from the No Action and the proposed new facility operation.

^c Hazard Index for MEI=sum of individual Hazard Quotients (noncancer health effects) for MEI.

^d Cancer risk for MEI=(emission concentrations) x (0.286 [converts concentrations to doses]) x (Slope Factor). Where there are no known carcinogens among the chemicals emitted, therefore the calculated cancer risk is 0.

^e Hazard Index for workers=sum of Individual Hazard Quotients (noncancer health effects) for workers.

^f Cancer risk for workers=(emission for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of lifetime working]) x (Slope Factor). Where there are no known carcinogens among the chemicals emitted, there are no Slope Factors; therefore the calculated cancer risk is 0.

Section M.3, Table M.3.4–47.

The HI to the MEI is 1.2×10^{-3} at the deep borehole complex site. The cancer risk to the MEI is zero (because no carcinogens are released from hazardous chemicals) at the deep borehole complex site. The HI to the onsite worker is 0.28 at the deep borehole complex generic site, and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals).

Facility Accidents. A set of potential accidents have been postulated for a deep borehole for disposal of immobilized Pu for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident scenarios considered are: earthquake, Pu storage container breakage, Pu storage container breach, pellet-grout mixing process facility fire, ceramic pellet spill, pellet-grout mix spill, dropped bucket during emplacement, failure of release-open early during emplacement, mixing system breaks pellets during bucket emplacement, pellets break during emplacement release, rupture of delivery pipe during pumped emplacement, mixing system breaks during pumped emplacement, pellets break during pumped emplacement, failure of ventilation filter, uncontrolled chemical reaction, pellet storage criticality, and pellet-grout mixing criticality. The range of consequences and risks for a set of accidents at the generic site are presented in Table 4.3.3.2.2.9–4. The estimated range of environmental data (wet to dry site) and the general public population density data (low to high density) for the generic site envelopes the site characteristics expected for the immobilized Pu disposition site.

[Text deleted.] The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Table 4.3.3.2.9-4. Range of Accident Impacts of the Deep Borehole Complex—Immobilized Disposition Alternative

Accident Scenario	Worker at 1,000 m				Maximum Offsite Individual				Population to 80 km				Accident Frequency (per yr)
	Risk of Cancer Fatality (per 10 yr) ^a		Probability of Cancer Fatality ^b		Risk of Cancer Fatality (per 10 yr) ^a		Probability of Cancer Fatality ^b		Risk of Cancer Fatalities (per 10 yr) ^c		Number of Cancer Fatalities ^b		
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	
Earthquake	5.7x10 ⁻¹⁸	2.3x10 ⁻¹⁸	5.7x10 ⁻¹⁴	2.3x10 ⁻¹⁴	1.2x10 ⁻¹⁸	5.2x10 ⁻²⁰	1.2x10 ⁻¹⁴	5.2x10 ⁻¹⁶	1.0x10 ⁻¹⁵	9.3x10 ⁻¹⁸	1.0x10 ⁻¹¹	9.3x10 ⁻¹⁴	1.0x10 ⁻⁵
Pu storage container breakage	5.7x10 ⁻¹⁸	2.3x10 ⁻¹⁸	5.7x10 ⁻¹⁶	2.3x10 ⁻¹⁶	1.2x10 ⁻¹⁸	5.2x10 ⁻²⁰	1.2x10 ⁻¹⁶	5.2x10 ⁻¹⁸	1.0x10 ⁻¹⁵	9.3x10 ⁻¹⁸	1.0x10 ⁻¹³	9.3x10 ⁻¹⁶	1.0x10 ⁻³
Pu storage container breach	5.7x10 ⁻¹⁸	2.3x10 ⁻¹⁸	5.7x10 ⁻¹⁶	2.3x10 ⁻¹⁶	1.2x10 ⁻¹⁸	5.2x10 ⁻²⁰	1.2x10 ⁻¹⁶	5.2x10 ⁻¹⁸	1.0x10 ⁻¹⁵	9.3x10 ⁻¹⁸	1.0x10 ⁻¹³	9.3x10 ⁻¹⁶	1.0x10 ⁻³
Pellet - grout mixing process facility fire	5.7x10 ⁻¹⁸	2.3x10 ⁻¹⁸	5.7x10 ⁻¹⁴	2.3x10 ⁻¹⁴	1.2x10 ⁻¹⁸	5.2x10 ⁻²⁰	1.2x10 ⁻¹⁴	5.2x10 ⁻¹⁶	1.0x10 ⁻¹⁵	9.3x10 ⁻¹⁸	1.0x10 ⁻¹¹	9.3x10 ⁻¹⁴	1.0x10 ⁻⁵
Ceramic pellet spill	5.7x10 ⁻¹⁹	2.3x10 ⁻¹⁹	5.7x10 ⁻¹⁷	2.3x10 ⁻¹⁷	1.2x10 ⁻¹⁹	5.2x10 ⁻²¹	1.2x10 ⁻¹⁷	5.2x10 ⁻¹⁹	1.0x10 ⁻¹⁶	9.3x10 ⁻¹⁹	1.0x10 ⁻¹⁴	9.3x10 ⁻¹⁷	1.0x10 ⁻³
Pellet grout mix spill	1.7x10 ⁻¹⁵	6.9x10 ⁻¹⁶	3.4x10 ⁻¹⁵	1.4x10 ⁻¹⁵	3.6x10 ⁻¹⁶	1.6x10 ⁻¹⁷	7.2x10 ⁻¹⁶	3.1x10 ⁻¹⁷	3.0x10 ⁻¹³	2.8x10 ⁻¹⁵	6.0x10 ⁻¹³	5.5x10 ⁻¹⁵	6.0x10 ⁻²
Bucket dropped during emplacement	5.7x10 ⁻¹⁵	2.3x10 ⁻¹⁵	5.7x10 ⁻¹¹	2.3x10 ⁻¹¹	1.2x10 ⁻¹⁵	5.2x10 ⁻¹⁷	1.2x10 ⁻¹¹	5.2x10 ⁻¹³	1.0x10 ⁻¹²	9.3x10 ⁻¹⁵	1.0x10 ⁻⁸	9.3x10 ⁻¹¹	1.0x10 ⁻⁵
Failure of release - opens early during bucket emplacement	2.8x10 ⁻¹⁴	1.1x10 ⁻¹⁴	2.8x10 ⁻¹⁰	1.1x10 ⁻¹⁰	5.9x10 ⁻¹⁵	2.6x10 ⁻¹⁶	5.9x10 ⁻¹¹	2.6x10 ⁻¹²	4.9x10 ⁻¹²	4.6x10 ⁻¹⁴	4.9x10 ⁻⁸	4.6x10 ⁻¹⁰	4.9x10 ⁻⁵
Mixing system breaks pellets during emplacement	5.7x10 ⁻¹⁴	2.3x10 ⁻¹⁴	5.7x10 ⁻¹²	2.3x10 ⁻¹²	1.2x10 ⁻¹⁴	5.2x10 ⁻¹⁶	1.2x10 ⁻¹²	5.2x10 ⁻¹⁴	1.0x10 ⁻¹¹	9.3x10 ⁻¹⁴	1.0x10 ⁻⁹	9.3x10 ⁻¹²	1.0x10 ⁻³
Pellets break during bucket emplacement release	5.7x10 ⁻¹⁴	2.3x10 ⁻¹⁴	5.7x10 ⁻¹²	2.3x10 ⁻¹²	1.2x10 ⁻¹⁴	5.2x10 ⁻¹⁶	1.2x10 ⁻¹²	5.2x10 ⁻¹⁴	1.0x10 ⁻¹¹	9.3x10 ⁻¹⁴	1.0x10 ⁻⁹	9.3x10 ⁻¹²	1.0x10 ⁻³
Rupture of delivering pipe during pumped emplacement	3.4x10 ⁻¹⁵	1.4x10 ⁻¹⁵	3.4x10 ⁻¹¹	1.4x10 ⁻¹¹	7.2x10 ⁻¹⁶	3.1x10 ⁻¹⁷	7.2x10 ⁻¹²	3.1x10 ⁻¹³	6.0x10 ⁻¹³	5.5x10 ⁻¹⁵	6.0x10 ⁻⁹	5.5x10 ⁻¹¹	1.0x10 ⁻⁵
Delivering pipe dropped during pumped emplacement	6.8x10 ⁻¹⁶	2.7x10 ⁻¹⁶	6.8x10 ⁻¹²	2.7x10 ⁻¹²	1.4x10 ⁻¹⁶	6.2x10 ⁻¹⁸	1.4x10 ⁻¹²	6.2x10 ⁻¹⁴	1.2x10 ⁻¹³	1.1x10 ⁻¹⁵	1.2x10 ⁻⁹	1.1x10 ⁻¹¹	1.0x10 ⁻⁵
Mixing system breaks pellets during pumped emplacement	6.8x10 ⁻¹⁵	2.7x10 ⁻¹⁵	6.8x10 ⁻¹³	2.7x10 ⁻¹³	1.4x10 ⁻¹⁵	6.2x10 ⁻¹⁷	1.4x10 ⁻¹³	6.2x10 ⁻¹⁵	1.2x10 ⁻¹²	1.1x10 ⁻¹⁴	1.2x10 ⁻¹⁰	1.1x10 ⁻¹²	1.0x10 ⁻¹³
Pellets break during pumped emplacement release	6.8x10 ⁻¹⁵	2.7x10 ⁻¹⁵	6.8x10 ⁻¹³	2.7x10 ⁻¹³	1.4x10 ⁻¹⁵	6.2x10 ⁻¹⁷	1.4x10 ⁻¹³	6.2x10 ⁻¹⁵	1.2x10 ⁻¹²	1.1x10 ⁻¹⁴	1.2x10 ⁻¹⁰	1.1x10 ⁻¹²	1.0x10 ⁻¹³
Failure of ventilation filter	3.4x10 ⁻¹⁸	1.4x10 ⁻¹⁸	3.4x10 ⁻¹³	1.4x10 ⁻¹³	7.2x10 ⁻¹⁹	3.1x10 ⁻²⁰	7.2x10 ⁻¹⁴	3.1x10 ⁻¹⁵	6.0x10 ⁻¹⁶	5.5x10 ⁻¹⁸	6.0x10 ⁻¹¹	5.5x10 ⁻¹³	1.0x10 ⁻⁶
Uncontrolled chemical reaction	5.7x10 ⁻¹⁸	2.3x10 ⁻¹⁸	5.7x10 ⁻¹³	2.3x10 ⁻¹³	1.2x10 ⁻¹⁸	5.2x10 ⁻²⁰	1.2x10 ⁻¹³	5.2x10 ⁻¹⁵	1.0x10 ⁻¹⁵	9.3x10 ⁻¹⁸	1.0x10 ⁻¹⁰	9.3x10 ⁻¹³	1.0x10 ⁻⁶
Pellet storage criticality	1.4x10 ⁻¹⁰	6.2x10 ⁻¹¹	1.4x10 ⁻⁵	6.2x10 ⁻⁶	2.9x10 ⁻¹¹	1.0x10 ⁻¹²	2.9x10 ⁻⁶	1.0x10 ⁻⁷	6.3x10 ⁻⁹	3.3x10 ⁻¹¹	6.3x10 ⁻⁴	3.3x10 ⁻⁶	1.0x10 ⁻⁶

Table 4.3.3.2.2.9-4. Range of Accident Impacts of the Deep Borehole Complex—Immobilized Disposition Alternative—Continued

Accident Scenario	Worker at 1,000 m				Maximum Offsite Individual				Population to 80 km			
	Risk of Cancer Fatality (per 10 yr) ^a		Probability of Cancer Fatality ^b		Risk of Cancer Fatality (per 10 yr) ^a		Probability of Cancer Fatality ^b		Risk of Cancer Fatalities (per 10 yr) ^c		Number of Cancer Fatalities ^b	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
Pellet-grout mixing criticality	1.4×10^{-10}	6.2×10^{-11}	1.4×10^{-5}	6.2×10^{-6}	2.9×10^{-11}	1.0×10^{-12}	2.9×10^{-6}	1.0×10^{-7}	6.3×10^{-9}	3.3×10^{-11}	6.3×10^{-4}	3.3×10^{-6}
Expected risk ^d	2.8×10^{-10}	1.2×10^{-10}			5.9×10^{-11}	2.0×10^{-12}			1.3×10^{-8}	6.6×10^{-11}		1.0×10^{-6}

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the MED) or the number of cancer fatalities (for the population within 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the incident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks for each accident over the 10-year lifetime of the facility.

Note: The impacts shown are the maximum for the reference sites. All values are mean values.

Source: Calculated using the source terms in Tables M.5.2.8.1-3 and M.5.2.8.1-4 and the MACCS computer code.

4.3.3.2.2.10 Waste Management

This section summarizes the waste management impacts for the construction and operation of a deep borehole complex which disposes of the waste form produced by the ceramic immobilization facility outlined in Section 4.3.3.2.1.10. There is no spent nuclear fuel or HLW associated with the operation of the deep borehole facility; however, the product output from the immobilization facility is a stabilized coated ceramic pellet. Table 4.3.3.2.2.10–1 provides the operational waste volumes projected to be generated from the deep borehole facility for immobilized disposal. Facilities that would support the deep borehole facility would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, waste could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated on-site to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. For purposes of analysis, a pristine site with no waste management infrastructure was assumed for No Action because the deep borehole facility was assumed to be a rural setting where no waste is currently being generated. The incremental waste volumes generated from the deep borehole facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.2. A detailed description of the waste management activities that would be required to support the new deep borehole disposal facility can be found in Section E.3.3.2.

Construction and operation of a deep borehole disposal facility for immobilized disposal would require the construction of waste management facilities to treat and store generated TRU, low-level, mixed, hazardous, and nonhazardous wastes. Wastes generated during construction would consist of wastewater, and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any is generated it would be managed in accordance with all applicable Federal and State regulations.

Less than 1 m³ (120 gal) of liquid TRU waste generated per year from equipment decontamination would be treated in a waste handling facility to form grout. In the solids treatment area of the waste handling facility less than 1 m³ (<1 yd³) of solid TRU waste from process and facility operations, equipment decontamination, failed equipment, and used tools would be compacted, as appropriate, then packaged, assayed, and certified to the WIPP WAC or alternative treatment level. A small quantity (0.1 m³ [0.2 yd³]) of mixed TRU solid waste would require treatment and packaging to meet the current planning-basis WIPP WAC or alternative treatment level. Mixed TRU waste would be principally rubber gloves and leaded gloveboxes. To transport the TRU and mixed TRU wastes to WIPP (depending on decisions made in the ROD associated with the supplemental EIS being prepared for the proposed continued phased development of WIPP for disposal of TRU waste), one truck shipment every 15 years would be required.

An estimated 3 m³ (800 gal) of liquid LLW from process wash liquids and excess water from the borehole would be solidified in the waste handling facility. The solidified liquid LLW and solid LLW comprised of sealant residues, contaminated reagent containers, deformed shipping containers, wipes, rags, and paper clothing would result in approximately 5 m³ (7 yd³) of LLW that would require disposal at a DOE LLW disposal facility. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.002 ha/yr (0.004 acres/yr) at Hanford and ORR, 0.0008 ha/yr (0.002 acre/yr) at NTS and INEL, and 0.0006 ha/yr (0.002 acres/yr) at SRS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

Approximately 141 m³ (37,400 gal) of liquid hazardous waste consisting of 2 m³ (600 gal) of chemical makeup and reagents from the surface facility and 139 m³ (36,800 gal) of decontamination water, oil, antifreeze, and hydraulic fluid from the drilling and emplacing-borehole sealing facilities would be collected in DOT-approved

Table 4.3.3.2.2.10-1. Estimated Annual Generated Waste Volumes for the Deep Borehole Complex^a—Immobilized Disposition Alternative

Category	New Facility (m ³)	No Action (m ³)
Transuranic		
Liquid	0.5 ^b	None
Solid	0.5	None
Mixed Transuranic		
Liquid	0	None
Solid	0.1	None
Low-level		
Liquid	3 ^b	None
Solid	6	None
Mixed low-level		
Liquid	0	None
Solid	0	None
Hazardous		
Liquid	141	None
Solid	15	None
Nonhazardous (sanitary)		
Liquid	9,460	None
Solid	291	None
Nonhazardous (other)		
Liquid	6,060	None
Solid	1,250 ^c	None

^a No waste generation was assumed for No Action. Waste generation volumes for deep borehole disposal facility for immobilized disposal are from Table E.3.3.2-1. Waste effluent volumes (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in Table E.3.3.2-1.

^b Liquid TRU and LLW would be treated and solidified prior to disposal.

^c Includes rock cuttings, bentonite, and polymers from drilling and emplacing borehole sealing facilities.

containers and shipped to RCRA-permitted treatment and disposal facilities. An estimated 15 m³ (20 yd³) of solid hazardous waste such as wipes contaminated with oils, lubricants, and cleaning solvents would be compacted, as appropriate, and then packaged in DOT-approved containers and shipped to RCRA-permitted treatment and disposal facilities.

Approximately 9,460 m³ (2,500,000 gal) of liquid nonhazardous sanitary and industrial wastewater and 6,060 m³ (1,600,000 gal) of steam plant blowdown and evaporator condensate would require treatment in accordance with standard industrial practices. Treated wastewater would be designated as reclaimed water recycle and would be used as makeup to the cooling tower. Construction of sanitary, utility, and process wastewater treatment systems would be required. The 291 m³ (380 yd³) of solid nonhazardous waste such as paper, glass, discarded office material, and cafeteria waste would be shipped to a permitted landfill. The drilling and emplacing-borehole sealing facilities would generate approximately 1,250 m³ (1,630 yd³) of rock cuttings, bentonite, and polymers. As per customary drilling industry practices, these wastes would end up in mud pits and then filled with earth and leveled.

4.3.4 IMMOBILIZATION ALTERNATIVE CATEGORY

These sections describe three immobilization alternatives for the final disposition of Pu: Vitrification Alternative, Ceramic Immobilization Alternative, and Electrometallurgical Treatment Alternative (GBZ). The representative sites are: Hanford, NTS, INEL, Pantex, ORR, and SRS. The sections describe the construction and annual operational impacts of the immobilization alternative facilities on the following potentially affected areas: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomic, public and occupational health and safety, and waste management. The impacts for all of the alternatives in these sections are in addition to those associated with the pit disassembly/conversion facility (Section 4.3.1) and the Pu conversion facility (Section 4.3.2). The potential can-in-canister approach at SRS for either vitrification or ceramic immobilization has been described in Appendix O. Should either of these variants be selected, follow-on tiered NEPA documentation will be completed, as appropriate.

4.3.4.1 Vitrification Alternative

The environmental impacts described in the following sections are based on the analysis of a new vitrification facility described in Section 2.4.4.1. The representative sites used for this facility are: Hanford, NTS, INEL, Pantex, ORR, and SRS.

In accordance with the Preferred Alternative for surplus Pu disposition, the vitrification facility could be located at either Hanford or SRS. Further tiered NEPA review will be conducted to examine alternative locations, including new and existing facilities at these two sites, should the Preferred Alternative be selected at the ROD.

For the Vitrification Alternative, the analysis in Sections 4.3.4.1.1 to 4.3.4.1.10 assumes that a new facility would be built. However, there are several potential variations described in Table 2.4-1, some of which could potentially use existing facilities for portions of the operations. For example, under the can-in-canister approach, the existing DWPF at SRS could be used to provide vitrified glass for the outer canister which surrounds the inner can of vitrified Pu.

4.3.4.1.1 Land Resources

A new facility for the Vitrification Alternative would disturb 24 ha (60 acres) of land during construction, of which 12 ha (30 acres) would be used during operations. The need for buffer zones would be determined during site-specific, tiered NEPA documentation. Land use would be less if existing facilities were used for portions of the vitrification operation.

Construction and operation of the vitrification facility would not cause indirect land use impacts at the analysis sites. As discussed in Section 4.3.4.1.8, in-migration of workers should be required only during the operational phase. However, it is expected that housing construction should be sufficient to absorb the increase in population at each site. Therefore, offsite land use at the analysis sites would not be affected. Direct and indirect impacts to land resources during construction and operation are described by representative site.

Hanford Site

Land Use. The vitrification facility site would utilize vacant land in the 200 Areas adjacent to 200 East. Construction would be in conformance with existing and future land use as described in the *Hanford Site Development Plan* and with ongoing discussions in the Comprehensive Land Use Planning Process (HF DOE 1993c:13,14). According to the current *Hanford Site Development Plan*, 200 Area's land use is identified as waste operations which includes radioactive material management, processing, and storage. [Text deleted.]

Construction and operation would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. Construction of the vitrification alternative would be consistent with State and local (Benton, Franklin, and Grant counties and the City of Richland) land use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction and operation would be consistent with the industrialized landscape character of the 200 Areas and current VRM Class 5 designation. A potential visual impact during operation would be from stack plumes which would be visible from public viewpoints with high sensitivity levels including State Highways 24 and 240 and the City of Richland; however, because of the viewing distance and compatibility of the proposal with existing industrial character, visual impacts would not occur.

Nevada Test Site

Land Use. The potential location for the vitrification alternative would be on undeveloped land in Area 6 adjacent to the DAF. Construction and operation of the facility in Area 6 would not be in conformance with the current *Nevada Test Site Development Plan*, which designates the southeast area of NTS as a nonnuclear test area. [Text deleted.] However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as part of the NTS defense program material disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8,3-9; NT DOE 1996e:A-18). [Text deleted.]

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans policies, or controls of adjacent jurisdictions since none of these counties or municipalities currently undertake land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. Views of the proposed action would be blocked from sensitive viewpoints accessible to the public by mountainous terrain.

Idaho National Engineering Laboratory

Land Use. A new vitrification facility would be located on undeveloped land in the ICPP security area, which is situated within the central core area/Prime Development Land Zone of INEL (IN DOE 1992g:12). Construction and operation of the facility would be consistent with the current *Idaho National Engineering Laboratory Site Development Plan*, which designates the future land use of the ICPP as receiving and storing spent nuclear fuels and radioactive wastes (IN DOE 1994d:9-8). [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction would not be in conflict with land-use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operation would be compatible with the present visual character of INEL, which consists of large industrial facilities and stack plumes. Potential visual impacts could occur during operation during operation from additional stack plumes; however, the proposal would be consistent with the existing Class 5 industrial landscape character of the ICPP.

Pantex Plant

Land Use. The vitrification facility would be located on undeveloped land in Zone 4. The potential action would be inconsistent with the current *Pantex Site Development Plan* which designates Zone 4 for weapons and

weapon components staging (PX DOE 1995g:16). However, Pantex could revise the site development plan should Pantex be selected for this alternative.

Construction would not affect other site land uses. There would be no onsite impacts to prime farmland. The alternative would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] Construction and operation of the vitrification alternative would be consistent with the industrialized landscape character. The current VRM Class 5 designation of Zone 4 would not change.

Oak Ridge Reservation

Land Use. A new vitrification facility would be located on undeveloped land at the northwest quadrant of the Route 95/Bear Creek Road intersection. The alternative would be in conformance with the future land use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan* designates a portion of the site as a major waste management area (OR DOE 1991f:1-7). [Text deleted.]

Construction and operation would be compatible with ORR or offsite land uses. No prime farmlands exist onsite. The vitrification facility would not be in conflict with City of Oak Ridge land-use plans, policies, and controls since the current *Oak Ridge Area Land-Use Plan* designates the potential site for Industrial and Public land use.

Visual Resources. [Text deleted.] Construction and operation of the facility would change the current VRM Class 4 designation of the Bear Creek Road/Route 95 site to Class 5. Additionally, potential visual impacts could occur during operation from the new stack plumes. Construction and operation activities would be highly visible from Bear Creek Road and Route 95, public roadways with high sensitivity levels.

Savannah River Site

Land Use. A new vitrification facility would be located on undeveloped land in the F-Area. Facility construction and operation would conform with existing and future land use as designated by the current *Savannah River Site Development Plan*. According to the plan, current F-Area land use is designated industrial operations, while the future land use category is Primary Industrial Mission. Specifically, the F-Area is one of four SRS waste management facilities (SR DOE 1994d:11,12). [Text deleted.]

Construction and operation would not affect other SRS or offsite land uses. There is no prime farmland on SRS. Construction would not be in conflict with land-use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. [Text deleted.] Construction and operation would occur within an area of similar industrial landscape character. Potential visual impacts could occur during operation from additional stack plumes; however, the proposal would be consistent with the VRM Class 5 designation of the F-Area.

[Text deleted.]

4.3.4.1.2 Site Infrastructure

Implementation of the vitrification alternative for immobilization of Pu with radionuclides requires construction and operation of facilities to conduct the vitrification processes. The potential impacts to the site infrastructure at six representative DOE sites for construction and operation of a vitrification facility are described below. Data for construction and operation are presented in Appendix C. Site infrastructure changes resulting from such construction are presented in Table 4.3.4.1.2–1, and changes from operations in Table 4.3.4.1.2–2.

Hanford Site

[Text deleted.] Construction and operation of this facility would require construction of transportation links to existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operational requirements would have negligible impact on the site infrastructure.

Nevada Test Site

[Text deleted.] Construction and operation of this facility would require construction of transportation links to existing road and rail networks. Additional oil would be required during the period of construction and for operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers.

Idaho National Engineering Laboratory

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts would be negligible to the site infrastructure.

Pantex Plant

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts would be negligible to the site infrastructure.

Oak Ridge Reservation

Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers for construction use. Construction and operation of this facility would require construction of transportation links to existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operational impacts would be negligible to the site infrastructure.

Savannah River Site

[Text deleted.] If existing facilities were used for part of the operations, the construction impacts would be lower. Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide this additional oil from local suppliers for construction use. Construction and operation of this facility would require construction of transportation links to existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operational impacts would be negligible to the site infrastructure.

Table 4.3.4.1.2-1. Additional Site Infrastructure Needed for the Construction of the Vitrification Facility Alternative (Annual)

Facility Requirement	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	2,000	5	94,000	0	0
Hanford					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	347,500	63	9,428,800	21,039,531	0
Amount required in excess to site availability	0	0	0	0	0
NTS					
Site availability	176,844	45	5,716,000	0	0
Projected usage without facility	124,940	25	5,716,000	0	0
Projected usage with facility	126,940	30	5,810,000	0	0
Amount required in excess to site availability	0	0	94,000	0	0
INEL					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage without facility	232,500	42	5,820,000	0	11,340
Projected usage with facility	234,500	47	5,914,000	0	11,340
Amount required in excess to site availability	0	0	0	0	0
Pantex					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	46,266	10	795,166	7,200,000	0
Projected usage with facility	48,266	15	889,166	7,200,000	0
Amount required in excess to site availability	0	0	0	0	0
ORR					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	728,000	115	473,000	95,000,000	16,300
Amount required in excess to site availability	0	0	57,000 ^a	0	0
SRS					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	794,000	116	28,390,500	0	221,352
Projected usage with facility	796,000	121	28,484,500	0	221,352
Amount required in excess to site availability	0	0	94,000 ^a	0	0

^a Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996c; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

**Table 4.3.4.1.2-2. Additional Site Infrastructure Needed for the Operation of the
Vitrification Facility Alternative (Annual)**

Facility Requirement	Transportation		Electrical		Fuel		
	Roads (km)	Rail- roads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	<5	<5	12,000	3	378,500	0	0
Hanford							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	420	204	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	425	209	357,500	61	9,713,300	21,039,531	0
Amount required in excess to site availability	<5	<5	0	0	0	0	0
NTS							
Site availability	1,100 ^a	0	176,844	45	5,716,000	0	0
Projected usage without facility	645	0	124,940	25	5,716,000	0	0
Projected usage with facility	650	<5	136,940	28	6,094,000	0	0
Amount required in excess to site availability	0	<5	0	0	378,500 ^b	0	0
INEL							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage without facility	445	48	232,500	42	5,820,000	0	11,340
Projected usage with facility	450	53	244,500	45	6,198,500	0	11,340
Amount required in excess to site availability	<5	<5	0	0	0	0	0
Pantex							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	76	27	46,266	10	795,166	7,200,000	0
Projected usage with facility	81	32	58,266	13	1,173,666	7,200,000	0
Amount required in excess to site availability	<5	<5	0	0	0	0	0
ORR							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	71	27	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	76	32	738,000	113	757,500	95,000,000	16,300
Amount required in excess to site availability	<5	<5	0	0	341,500 ^b	0	0
SRS							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	230	103	794,000	116	28,390,500	0	221,352
Projected usage with facility	235	108	806,000	119	28,769,000	0	221,352
Amount required in excess to site availability	<5	<5	0	0	378,500 ^b	0	0

^a Includes paved and unpaved roads.

^b Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996c; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

4.3.4.1.3 Air Quality and Noise

Construction and operation of the vitrification facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.4.1.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM₁₀ and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction. Construction impacts would be lower if existing facilities were used.

Emission rates for operation of the vitrification facility are presented in Table F.1.3–9. Air pollutant emissions sources associated with operations include the following:

- Increased operation of existing boilers for space heating
- Operation of diesel generators, diesel driven pumps, and periodic testing of emergency diesel generators
- [Text deleted.]

The PSD regulations, which are designed to protect ambient air quality in attainment areas, apply to new sources and major modifications to existing sources. Based on the emission rates presented in Appendix F, PSD permits may be required for this alternative at any of the sites. This may require “offsets” (reductions of existing emissions) to permit any additional or new emission source.

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for facility operation, plus the No Action concentrations, are presented in Table 4.3.4.1.3–1. VOCs are the only toxic/hazardous emissions and were not modeled for this PEIS.

Table 4.3.4.1.3-1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Vitrification Alternative and No Action Alternative

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines ^a (µg/m ³)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No	Total	No	Total	No	Total	No	Total	No	Total	No	Total
			Action (µg/m ³)	(µg/m ³)	Action (µg/m ³)	(µg/m ³)	Action (µg/m ³)	(µg/m ³)	Action (µg/m ³)	(µg/m ³)	Action (µg/m ³)	(µg/m ³)	Action (µg/m ³)	(µg/m ³)
Criteria Pollutants														
Carbon monoxide	8-hour	10,000	0.08	11.49	2,290	2,299.06	284	312.6	602	712.3	5	7.83	22	119.5
	1-hour	40,000	0.3	90.92	2,748	2,812.03	614	686.5	2,900	3,475	11	16.85	171	630.2
Lead	Calendar Quarter	1.5	<0.01	<0.01	b	b	0.001	0.001	0.09	0.09	0.05	0.05	<0.01	<0.01
	24-hour	0.5	<0.01	<0.01	c	c	c	c	c	c	c	c	c	c
Nitrogen dioxide	Annual	100	0.03	0.44	b	0.06 ^d	4	4.55	2.15	4.42	3	3.09	5.7	7.47
Ozone	1-hour	235	e	e	e	e	e	e	e	e	e	e	e	e
Particulate matter less than or equal to 10 microns in diameter	Annual	50	<0.01	<0.01	9.4	9.4	5	5	8.73	8.75	1	1	3	3.01
	24-hour	150	0.02	0.05	106	106.02	80	80.08	88.5	88.81	2	2.01	50.6	50.87
Sulfur dioxide	Annual	52	<0.01	0.02	8.4	8.4	6	6.01	<0.01	0.06	2	2	14.5	14.55
	24-hour	260	<0.01	0.11	94.6	94.68	135	135.27	<0.01	0.99	32	32.02	196	196.9
	3-hour	1,300	0.01	0.78	725	725.55	579	580.2	<0.01	5.49	80	80.09	823	828.7
	1-hour	1,018	0.02	2.34	c	c	c	c	c	c	c	c	c	c
	1-hour	655 ^f	0.02	2.34	c	c	c	c	c	c	c	c	c	c
	30-minute	1,045	c	c	c	c	c	c	<0.01	14.74	c	c	c	c
Mandated by State														
Gaseous fluorides (as HF)	30-day	0.8	b	b	c	c	c	c	<0.75	<0.75	0.2	0.2	0.09	0.09
	7-day	1.6	b	b	c	c	c	c	<0.75	<0.75	0.3	0.3	0.39	0.39
	24-hour	2.9	b	b	c	c	c	c	0.75	0.75	0.6 ^g	0.6 ^g	1.04	1.04
	12-hour	3.7	b	b	c	c	c	c	1.05	1.05	0.6 ^g	0.6 ^g	1.99	1.99
	8-hour	250	b	b	c	c	c	c	c	c	0.6	0.6	c	c
	3-hour	4.9	b	b	c	c	c	c	4.21	4.21	c	c	c	c
Hydrogen sulfide	1-hour	112	c	c	b	b	c	c	c	c	c	c	c	c
	30-minute	111	c	c	c	c	c	c	b	b	c	c	c	c
Total suspended particulates	Annual	60	<0.01	<0.01	c	c	5	5	c	c	c	c	12.6	12.61
	24-hour	150	<0.02	0.05	c	c	80	80.08	c	c	2	2.01	c	c

Table 4.3.4.1.3-1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Vitrification Alternative and No Action Alternative—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines ^a									
		Hanford		NTS		INEL		Pantex		ORR	
		No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)
Total suspended particulates (continued)	3-hour	c	c	c	c	c	c	b	1.70 ^d	c	c
	1-hour	c	c	c	c	c	c	b	4.58 ^d	c	c
[Text deleted.]											

^a The more stringent of the Federal and State standards is presented for the averaging time.

^b No sources for this pollutant have been identified.

^c No State standard for indicated averaging time.

^d The concentration represents the alternative contribution only.

^e Ozone, as a criteria pollutant, is not directly emitted or monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

^f At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.

^g 8-hour averaging time concentration was used.

Note: Total concentrations are based on site contribution, including contribution from ongoing activities (No Action), and do not include the contribution from non-facility sources.

Concentrations for other hazardous/toxic pollutants reported for No Action in Section 4.2 are unchanged for this alternative and are not shown here.

Source: 40 CFR 50; ID DHW 1995a; ID DHW 1995b; LLNL 1996c; NV DCNR 1995a; SC DHEC 1991a; SC DHEC 1992b; TN DEC 1994a; TN DHE 1991a; TX ACB 1987a; TX NRCC 1992a; TX NRCC 1995a; WA Ecology 1994a.

NOISE

The location of the facilities associated with the vitrification facility relative to the site boundary and sensitive receptors was examined for each of the six sites to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction materials and workers to the site.

Nontraffic noise associated with operation of these facilities would include ventilation systems, cooling systems, and emergency diesel generators. These noise sources would be located at sufficient distance from offsite areas, so that the contribution to offsite noise levels would continue to be small. Due to the size of the sites, noise emission from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.4.1.4 *Water Resources*

The construction and operation of a vitrification facility would affect surface water and groundwater resources. Water resource requirements and discharges provided in Table C.1.1.3–4, Table C.2.1.3–4, and Table E.3.3.4–1 were used to assess impacts to surface water and groundwater. The discussion of impacts is provided for each site separately. Table 4.3.4.1.4–1 presents No Action surface water and groundwater uses and discharges at each site, and the potential changes resulting from construction and operation of the vitrification facility.

Hanford Site

Surface Water. Surface water from the Columbia River would be used as the water source for construction and operation of the vitrification facility. During construction, the quantity of water required would be approximately 10.6 million l/yr (2.8 million gal/yr), which would represent less than a 0.08-percent increase over the expected annual surface water withdrawal. This additional withdrawal would not affect surface water availability. During operation, the total annual water requirement would be approximately 250 million l/yr (66 million gal/yr). This would represent a 1.9-percent increase over the existing surface water withdrawal and approximately 0.0002 percent of the average annual flow of the Columbia River and would cause negligible impacts.

[Text deleted.]

During construction of the vitrification facility, sanitary wastewater (4.6 million l/yr [1.2 million gal/yr]), would be generated, treated, and discharged to evaporation/percolation ponds. [Text deleted.] During operation, approximately 197 million l/yr (52 million gal/yr) of sanitary and other wastewater would be recycled or discharged to evaporation/percolation ponds. All discharges would be monitored to comply with discharge requirements.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown, etc.) would be monitored, collected, and treated if necessary prior to either recycling within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity; effluents would be automatically diverted to the effluent retention tank if contamination were detected.

The vitrification facility would be located in the 200 Area which is above the 100-year, 500-year and probable maximum flood boundaries; flooding from dam failures; and flooding from a landslide resulting in river blockage.

Groundwater. No groundwater would be used for construction or operation of the vitrification facility; therefore, there would be no impact to groundwater availability.

Construction and operation of the vitrification facility would not result in direct discharges to groundwater. Treated wastewater would be discharged to disposal ponds which does not evaporate, however, could percolate downward into the near surface aquifer groundwater. This water would be monitored and would not be discharged until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. Other factors limiting the potential impacts to groundwater quality are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Nevada Test Site

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the vitrification facility. Therefore, there would be no impacts to surface water availability.

Table 4.3.4.1.4-1. Potential Changes to Water Resources Resulting From the Vitrification Alternative

Water Source	Affected Resource Indicator		Hanford		NTS		INEL		Pantex		ORR		SRS	
			Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground
No Action														
No Action water requirements (millions l/yr)			13,511	2,400	13,511	2,400	7,570	249	14,760	13,247				
No Action wastewater discharges (millions l/yr)			246	82	246	82	540	141	2,277	700				
Construction														
Water Availability and Use														
Total water requirement (million l/yr)			10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6				
Percent increase in project water use ^a			0.08	0.4	0.08	0.4	0.1	4.3	0.07	0.08				
Water Quality														
Total wastewater discharge (million l/yr)			4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6				
Percent change in wastewater discharge ^b			1.9	5.6	1.9	5.6	0.9	2.5	0.2	0.7				
Percent change in streamflow			neg	NA	neg	NA	NA	NA	0.01 ^c	0.09 ^d				
Operation														
Water Availability and Use														
Total water requirement (million l/yr)			250	250	250	250	250	250	250	250				
Percent increase in projected water use ^e			1.9	10.4	1.9	10.4	3.3	100.4	1.7	1.9				
Water Quality														
Wastewater discharge (million l/yr)			197	197	197	197	197	197	197	197				
Percent change in wastewater discharge ^f			80.1	240	80.1	240	36.5	139.7	8.7	28.1				
Percent change in streamflow			neg	NA	neg	NA	NA	NA	0.4 ^c	3.9 ^d				
Floodplain														
Action in 100-year floodplain			No	No	No	No	No	No	No	No				
Critical action in 500-year floodplain			No	Uncertain	No	Uncertain	Uncertain	No	Uncertain	Unlikely				

^a Percent increases in water requirements during construction of the vitrification facility are calculated by dividing water requirements for the facility (10.6 million l/yr) with that for each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), and SRS (13,247 million l/yr).

^b Percent changes in wastewater discharged during construction of the vitrification facility are calculated by dividing wastewater discharges for the facility (4.6 million l/yr) with that for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), and SRS (700 million l/yr).

^c Percent changes in stream flow from wastewater discharges are calculated from the average flow of Clinch River (132 m³/s) and East Fork Poplar Creek (1.5 m³/s). The comparison for the East Fork Poplar Creek is shown in the table.

^d Percent changes in stream flow from wastewater discharges are calculated from the minimum flow of the Fourmile Branch (0.16 m³/s).

^e Percent increases in water requirements during operation of the vitrification facility are calculated by dividing water requirements (250 million l/yr) with that for each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), and SRS (13,247 million l/yr).

^f Percent changes in wastewater discharged during operation of the vitrification facility are calculated by dividing wastewater discharge rate for the new facility (197 million l/yr) with that for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), and SRS (700 million l/yr).

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996c; NTS 1993a:4; OR LMES 1995c; PX 1995a:1; SRS 1995a:2.

[Text deleted.]

During construction of the vitrification facility, sanitary wastewater 4.6 million l/yr (1.2 million gal/yr), would be generated. During operation, approximately 197 million l/yr (52 million gal/yr) of sanitary and other wastewater would be discharged to a new wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycling.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Condensation from heating, air conditioning, and other distillates; fire sprinkler water; and truck hose-down water would be monitored for radioactivity, and if uncontaminated, available for recycling or discharge to natural drainage channels.

There have been no studies to assess the 500-year floodplain boundaries at NTS. Information on the 500-year floodplain could be developed in future environmental studies. Studies have shown the 100-year floodplain to be confined to the Jackass Flats and Frenchman Lake areas. The proposed sites for the vitrification facility are not located in either of these areas. However, since the NTS is in a region where most flooding occurs by locally intense thunderstorms which can create brief (less than 6 hours) flash floods, the facility would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater. Quantities required for construction and operation and the percent increase in projected water use are shown in Table 4.3.4.1.4-1. Annual construction water requirements for the facilities (10.6 million l/yr [2.8 million gal/yr]), would represent less than 0.03 percent of the minimum estimated annual recharge to the regional aquifer under the NTS (38 billion l [10 billion gal]) and a 0.4-percent increase over the projected groundwater usage. Operating the facility at NTS would require 250 million l/yr (66 million gal/yr), which would be approximately 10.4 percent of the projected groundwater usage and 0.7 percent of the minimum estimated annual recharge. This additional amount would increase the total amount withdrawn annually at NTS to 7.0 percent of the estimated annual recharge. These additional withdrawals would not impact groundwater availability.

Construction and operation of the vitrification facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are therefore not expected. Other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the vitrification facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the vitrification facility, sanitary wastewater (4.6 million l/yr [1.2 million gal/yr]) would be generated, treated, and discharged to evaporation/percolation ponds, or would be available for recycling. All discharges would be monitored to comply with discharge limits. During operation, approximately 197 million l/yr (52 million gal/yr) of sanitary and other wastewater would be either treated and discharged to

evaporation/percolation ponds or available for recycling. This amount would increase wastewater discharges by 36.5 percent. All discharges would be monitored to comply with discharge limit.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown, etc.) would be monitored, collected, and treated if necessary prior to recycling within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity; effluents would be automatically diverted to the effluent retention tank if contamination is detected.

The potential site for the vitrification facility is not located in an area historically prone to flooding, but is within the flood zone which would occur as a result of the failure of the MacKay Dam during a maximum probable flood, which would be more critical than either the 100- or 500-year flood. Because INEL is in a region where flash floods could occur, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. Water requirements for operation of the vitrification facility would fall within INEL's current allotment. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). As shown in Table 4.3.4.1.4-1, construction water requirements (10.6 million l/yr [2.8 million gal/yr]) for the proposed facilities, which are small relative to INEL's total usage, would represent a 0.1-percent increase over the projected annual groundwater usage. Minimal impacts to groundwater availability would occur. During operation, the water requirements for the facility would be 250 million l/yr (66 million gal/yr), which represents a 3.3-percent increase over the projected No Action annual groundwater usage. INEL would still be well within the total groundwater allotment.

Construction and operation of the vitrification facility would not result in direct discharges to groundwater and would not be expected to contribute to existing near surface contamination. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are therefore not expected. Other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates. Because no new groundwater supply wells would be installed, the vitrification facility is not expected to affect existing groundwater contamination in the ICPP area.

Pantex Plant

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the vitrification facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the vitrification facility, sanitary wastewater (4.6 million l/yr [1.2 million gal/yr]) would be generated and would be discharged to the existing wastewater treatment systems north of Zone 12. During operation, approximately 197 million l/yr (52 million gal/yr) of sanitary wastewater and other wastewater would be discharged to these wastewater treatment systems. After treatment, all wastewater generated during construction and operation would be discharged to the playa lakes or would be recycled. Since Pantex discharged approximately 1.4 million l/day (0.37 million gal/day) of wastewater into the playas in 1994 and is expecting this quantity to decrease in the future, the estimated quantity of additional wastewater that would be discharged to the playas (approximately 539,700 l/day [142,600 gal/day]) should not cause any exceedances of the monthly average limit of 2.46 million l/day (650,000 gal/day).

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown) would be monitored, collected, and treated if necessary prior to recycling within the facility or discharge to the playas. These wastes would be sampled continuously for radioactivity; effluents would be automatically diverted to the effluent retention tank if contamination were detected.

The proposed location for the vitrification facility is in Zone 4. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in Zone 4, there would be no impacts to floodplains. However, flooding in other areas of Pantex could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. All water required for construction and operation would be supplied from groundwater using the existing supply system which obtains water from the Ogallala Aquifer or possibly from reclaimed wastewater. Construction water requirements for the vitrification facilities would be small relative to the recoverable water in aquifer storage, which for the year 2010 was estimated to be 287 trillion l (75.8 trillion gal) (PX WDB 1993a:1). As shown in Table 4.3.4.1.4–1, construction of the facilities would require 10.6 million l/yr (2.8 million gal/yr) of water, which would represent approximately a 4.3-percent increase over the No Action annual groundwater usage and 0.6 percent of the capacity of groundwater system (1,900 million l/yr [502 million gal/yr]). [Text deleted.] Previous studies have shown that when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala Aquifer, an average of 1.8 m/yr (5.9 ft/yr) decline in the water table occurred over a 10-year period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the proposed vitrification facilities at Pantex would require 250 million l/yr (66 million gal/yr), resulting in a small drawdown representing 13.2 percent of the capacity of the groundwater system. This additional drawdown would not impact regional groundwater levels. The water requirements would be approximately 13.1 percent of the capacity of the groundwater system and about a 100-percent increase in projected No Action water usage. The total site groundwater withdrawal including this facility would be 499 million l/yr (131.8 million gal/yr) which, because of expected cutbacks in other programs, would be 40 percent less than the 836 million l/yr (221 million gal/yr) currently being withdrawn from wells at Pantex.

Construction and operation of the vitrification facilities would not result in direct discharges to groundwater. Treated wastewater discharged to playas, however, could percolate downward into the groundwater of the near surface aquifer. This water would be monitored and would not be discharged to the playas until contaminant levels are within the limits specified by the TNRCC. [Text deleted.]

Although the expected drawdowns caused by withdrawing the water required for this alternative are small, the overall decline in groundwater levels in the Amarillo area is of concern. Possible groundwater conservation measures at Pantex that could be considered including decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Oak Ridge Reservation

Surface Water. Water required for construction and operation of the vitrification facility would be obtained from the Clinch River and its tributaries. [Text deleted.]

During construction, the quantity of water required would be approximately 10.6 million l/yr (2.8 million gal/ yr), which would represent a 0.07-percent increase over the projected annual surface water withdrawal. During operation, water requirements would be approximately 250 million l/yr (66 million gal/yr), which would represent a 1.7-percent increase over the projected No Action annual surface water withdrawal and would be 0.006 percent

of the average flow of the Clinch River ($132 \text{ m}^3/\text{s}$ [$4,647 \text{ ft}^3/\text{s}$]). Minimal impacts to surface water availability would occur.

During construction of the vitrification facility, sanitary wastewater (approximately 4.6 million l/yr [1.2 million gal/yr]) would be generated, treated, and discharged to East Fork Poplar Creek. During operation, a total of 197 million l/yr (52 million gal/yr) of sanitary wastewater would be generated by the new facility. This quantity would represent less than 0.4 percent of the average flow of East Fork Poplar Creek and would be a 8.7-percent increase in wastewater discharges. All discharges would be monitored to comply with discharge requirements. No impacts are expected.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown) would be monitored, collected, and treated if necessary prior to recycling within the facility or discharge to natural drainage channels. These wastes would be sampled continuously for radioactivity; effluents would be automatically diverted to the effluent retention tank if contamination were detected.

The potential location of the vitrification facility is outside the 100-year floodplain; there would be no impact to the floodplain. The 500-year floodplain has not been determined in this area but could be developed in future studies.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater; therefore, neither groundwater quality nor availability would be affected.

Savannah River Site

Surface Water. Groundwater would be used for construction and operation of a new vitrification facility. No surface water withdrawals would be made. [Text deleted.] During construction of the vitrification facility, sanitary and other nonhazardous wastewater (approximately 4.6 million l/yr [1.2 million gal/yr]) would be generated and discharged to the sitewide wastewater treatment system, which would not require any modifications. This would represent a 0.7-percent increase in the wastewater discharge from this facility. If existing facilities were used there would be less water used and wastewater discharged during construction. During operation, approximately 197 million l/yr (52 million gal/yr) of sanitary wastewater would be discharged to this wastewater treatment system. This would represent a 28.1-percent increase in the effluent discharged to Fourmile Branch from this facility. This discharge would not exceed 3.9-percent of the minimum flow of this stream. All discharges would be monitored to comply with discharge requirements. [Text deleted.] Other nonhazardous wastewater effluents (for example, condensation from air conditioning and heating, fire sprinkler water, cooling system blowdown) would be collected, monitored, and treated if necessary prior to recycling within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity; effluents would be automatically diverted to the effluent retention tank if contamination were detected.

The potential location of the vitrification facility is outside the 100-year floodplain. Although information on the location of the 500-year floodplain at SRS is currently available only for a limited number of specific project areas, the vitrification facility at SRS would not likely affect, or be affected by the 500-year floodplain of either the Fourmile Branch or Upper Three Runs Creek. This is because facility would be located at an elevation of about 91 m (300 ft) above MSL and is approximately 33 m (107 ft) and 64 m (210 ft) above these streams and at distances from these streams of 0.8 km (0.5 mi) to 1.5 km (0.94 mi), respectively. The maximum flow that has occurred on the Upper Three Runs Creek was in 1990, with a flow rate of about $58 \text{ m}^3/\text{s}$ ($2,040 \text{ ft}^3/\text{s}$). At that time the creek reached an elevation of almost 30 m (98 ft) above MSL (SR USGS 1996a:1). The elevations of the buildings in F-Area are more than 62 m (202 ft) above the highest flow elevation of the Upper Three Runs Creek. The maximum flow that has occurred on the Fourmile Branch was in 1991 with a rate of approximately $5 \text{ m}^3/\text{s}$ ($186 \text{ ft}^3/\text{s}$), and an elevation of about 61 m (199 ft) above MSL (SR USGS 1996a:1). Elevations of the

vitrification buildings in F-Area would be more than approximately 31 m (101 ft) higher than the maximum flow level that has occurred.

Groundwater. During construction, the quantity of water required would be approximately 10.6 million l/yr (2.8 million gal/yr), which would represent less than a 0.08-percent increase over the projected No Action annual groundwater withdrawal. This additional withdrawal would cause minimal impacts to groundwater availability.

During operation, water used for cooling system makeup would be obtained from existing supply systems in the F-Area. The water for these systems is groundwater from the Cretaceous Aquifer. The total annual water requirements of 250 million l/yr (66 million gal/yr) shown in Table 4.3.4.1.4–1 represent a 1.9-percent increase in the projected groundwater usage at SRS. There would be reduced impacts if existing facilities are used. These additional withdrawals would not impact regional groundwater levels. Previous studies using numerical simulations of groundwater withdrawals over 100 times greater than that required for the vitrification facility from the Cretaceous Aquifer indicate drawdown of almost 2.1 m/yr (6.9 ft/yr) at the well head, but would be less in overlying aquifers and not extend beyond SRS boundaries in any aquifer (DOE 1991c:5-196). Therefore, it is expected that the withdrawals attributed to the facility would cause a slight drawdown at the well head and would not affect any aquifers in the area. No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected.

[Text deleted.]

4.3.4.1.5 *Geology and Soils*

This section describes the environmental impacts to the geologic and soil resource as related to the construction and operation of the vitrification facility. This facility at any of the alternative sites, would involve some ground-disturbing construction activities (24 ha [60 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. The relative amount of annual precipitation (rain) is greater at ORR and SRS than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on the geologic resource are anticipated. Neither facility construction and operational activities or site infrastructure improvements would restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is low for Pantex, Hanford, INEL, and NTS. The soil erosion potential for ORR and SRS during construction and operational activities is moderate due primarily to greater relative annual precipitation. Soil disturbance would occur primarily from ground-breaking construction activities (foundation preparation) and associated with building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (increase wind velocities and durations increase potential soil erosion), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns. Soil loss associated with construction would be less if existing facilities were used for part of the vitrification process.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvement (buildings, roads, and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal. [Text deleted.]

4.3.4.1.6 *Biological Resources*

Construction of the vitrification facility would require 24 ha (60 acres) of land at each of the DOE sites analyzed. This includes areas on which plant facilities would be constructed, as well as areas used for construction laydown. Land requirements and impacts on biological resources would be less if existing facilities were used for portions of the vitrification operations. Consultation with USFWS and State agencies would be conducted at the site-specific level as appropriate to avoid potential impacts to threatened and endangered species, and other protected species and habitat.

Hanford Site

It is assumed that a new vitrification facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the vitrification facility would result in the disturbance of terrestrial habitat equaling about 0.02 percent of Hanford. This includes areas on which plant facilities would be constructed, as well as areas revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. The assumed facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the vitrification facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the vitrification facility. These disturbances may cause some species to move from the area. Disturbances to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the vitrification facility would not affect wetlands since no wetlands exist near the assumed facility location. Groundwater would be used and wastewater would be discharged to evaporation/infiltration ponds; therefore, wetlands would not be affected.

Aquatic Resources. Construction of a vitrification facility at Hanford would not impact aquatic resources since there are no surface water bodies sufficiently near the assumed facility location to be affected by runoff. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure so impacts to aquatic resources from impingement and entrainment would be minimal. Since the volume of water included represents a small percentage of the flow of the river, flow-related impacts to aquatic resources would be minimal. Wastewater would be discharged to evaporation/infiltration ponds; therefore, aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the vitrification facility; however, sagebrush habitat would be disturbed. The sagebrush community is important nesting/breeding and foraging habitat for several State-listed and candidate species such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate prior to construction to determine the existence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the vitrification facility would be located in the Frenchman Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are described below.

Terrestrial Resources. Construction and operation of the vitrification facility at NTS would result in the disturbance of terrestrial habitat equaling about 0.007 percent of NTS. This includes areas on which facilities would be constructed, as well as areas used for construction laydown. Vegetative cover within the assumed facility location, which is primarily creosote bush (Figure 3.3.6–1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the vitrification facility would affect animal populations. Less mobile animals, such as reptiles and small mammals, within the project area would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitats nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the vitrification facility would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the vitrification facility would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location.

Threatened and Endangered Species. The threatened desert tortoise is a federally listed species that could be affected by construction of the vitrification facility at NTS. Construction activities such as land clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicular traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training; putting restrictions on vehicle speeds and off-road movement; conducting clearance surveys prior to surface disturbance; approving stop work authority if tortoises are found within work areas; removing tortoises from roadways and work areas; placing permanent and temporary tortoise proof fencing around trenches, landfills, and treatment ponds; inspecting trenches; and having biologists survey when heavy equipment is in use. The

USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the vitrification facility.

[Text deleted.] Any listed plant species (Table 3.3.6–1) located within the construction area would be lost during land-clearing activities. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicular traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on the NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the vitrification facility (Section 4.3.4.1.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that the vitrification facility would be constructed within an undeveloped portion of the ICPP area. The ICPP area falls within the big sagebrush/thickspike wheatgrass/needle-and-thread grass community. Impacts to wildlife would be limited to smaller mammals and some birds and reptiles which could be displaced or suffer mortality. Larger mammals are excluded from the site by the perimeter fence and thus would not be impacted. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the area would have already adapted to similar disturbances. Due to the lack of wetlands or aquatic resources near the assumed facility location, these resources would not be affected by construction or operation of the vitrification facility. Since the facility would be located within the ICPP security area, impacts to threatened and endangered species would not be expected since they are not present at the ICPP.

Pantex Plant

It is assumed that the vitrification facility would be located within Zone 4, which is a developed area that lacks natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the assumed facility location; however, small mammals and some birds and reptiles could be displaced by construction. Since Zone 4 does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the vitrification facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional wastewater could lead to an increase in open water near the outfall, as well as a change in plant species composition. It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of the vitrification facility. Although the assumed facility location has been disturbed, the State-listed Texas horned lizard could be present. Preactivity surveys would be conducted as appropriate prior to construction.

Oak Ridge Reservation

It is assumed that the vitrification facility would be located about 3 km (5 miles) east of the K-25 area of ORR. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the vitrification facility at ORR would result in the disturbance of about 0.2 percent of ORR. This acreage includes areas on which the facility would be constructed, as well as areas that would be revegetated following construction.

Vegetation within the area to be developed would be destroyed during land clearing. Vegetation cover within the assumed site is predominantly oak-hickory forest or pine and pine-hardwood forest. While both types would be affected by construction, it is likely that a greater area of pine and pine-hardwood forests would be removed. This type of forest is more heavily concentrated in valleys where most of the development would occur. Oak-hickory forests are typically found on ridges. Both forest types are common throughout ORR and within the region.

Construction of the proposed facility would affect animal populations. Less mobile animals within the assumed project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the proposed facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Because the majority of the area in which the proposed facility would be located is upland, it is expected that direct impacts to wetlands could be avoided. Implementation of erosion and sediment control measures would control secondary impacts. Since an existing intake structure would be used during both construction and operation, it would not be necessary to disturb wetlands along the Clinch River. However, a new wastewater discharge structure could be required on East Fork Poplar Creek. Depending on its location, this structure could displace some wetlands along the creek. Any unavoidable impacts to wetlands would be mitigated in accordance with 10 CFR 1022.

During construction and operation, discharges would be directed to East Fork Poplar Creek. Discharges would have a minimal impact on the flow of the stream and are not expected to affect associated wetlands. All wastewater discharges would be treated as necessary to meet NPDES permit requirements.

Aquatic Resources. Construction and operation of the vitrification facility could cause water quality changes (primarily sediment loading and resulting turbidity) to Bear Creek, Grassy Creek, or Ish Creek as a result of soil erosion. Soil erosion and sediment control measures would be implemented to control erosion. Water requirements during both construction and operation would be met by existing site sources. Since a new intake structure would not be required, direct disturbance to aquatic resources in the Clinch River would not occur. Water withdrawal during construction and operation would represent a very small percentage of the Clinch River's average flow and would have little effect on the flow of the river. Increases in impingement and entrainment impacts would, therefore, be minimal and would be unlikely to affect fish populations in the river. During construction and operation, wastewater would be discharged to East Fork Poplar Creek. This could require the construction of a new discharge structure which would temporarily disturb aquatic habitat in the vicinity of the outfall. The small volume of wastewater discharged to the stream would provide minimal impacts to aquatic resources during either construction or operation.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species are expected to be affected by construction of the vitrification facility. Land-clearing activities may destroy State protected plant species found within or adjacent to disturbed portions of the assumed site including pink lady's-slippers, fen orchid, tubercled rein-orchid, American ginseng, purple fringeless orchid, Canada lily, and golden seal. The Tennessee dace is sensitive to siltation and actively seeks clean gravel for spawning. An increase in amount or duration of sediment runoff to Ish Creek or Bear Creek during facility construction could impact this fish species. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of special status species in the area to be disturbed. No additional impacts are expected during operation of the facility. [Text deleted.]

Savannah River Site

It is assumed that a new vitrification facility would be constructed within the F-Area, which is one of the highly developed industrial areas of SRS. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area would have already adapted to similar disturbances. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since water would be taken from existing sources and discharged via NPDES permitted outfalls and would involve minor volumes. Impacts from construction and operation of the vitrification facility would not be expected to impact threatened and endangered species due to the developed nature of the assumed facility location. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the site that this species would not be directly affected by this action.

4.3.4.1.7 Cultural and Paleontological Resources

This section discusses the potential impacts to cultural and paleontological resources that may result from the construction and operation of the vitrification facility at each of the representative sites analyzed. The total land disturbed during the construction of this facility is 24 ha (60 acres), of which 12 ha (30 acres) would be used during operation. [Text deleted.] If existing facilities were used for a portion of the vitrification operation, less land would be disturbed and there would be fewer impacts to cultural and paleontological resources. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, building modification, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources were identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. Any such sites may be identified through additional surveys. Any identified sites would be avoided. Operation would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified in close proximity to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The vitrification facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed lands necessary for the proposed facility may contain similar prehistoric or historic resources. Impacts to resources would occur during construction, but not operation, of the proposed facility.

The CGTO conducted surveys over portions of Frenchman Flat and identified at least 20 significant plant species. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from the construction and operation of the facility. Impacts could include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological remains may be affected by construction, but not operation, of the facility.

Idaho National Engineering Laboratory

The vitrification facility would be constructed within the existing ICPP security area. The facility would be sited in a location previously approved for the construction of the Special Isotope Separation Project. A surface survey of the area identified no sites within the proposed project area. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archaeological remains be discovered during construction. Two historic sites occur adjacent to the ICPP—one historic can scatter across the Big Lost River, to the northeast, and one abandoned homestead to the east. The can scatter is not considered eligible for NRHP-listing and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed action. Facility construction and operation may have a visual or auditory impact on traditional use areas or sacred sites. Such resources may be identified through consultation with the interested tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain which have produced fossilized remains. Operation would not have an effect on paleontological resources.

Pantex Plant

The vitrification facility would be constructed in Zone 4 of Pantex. A historic buildings survey was conducted in Zone 4 to identify significant World War II Era structures and none of the buildings there are considered NRHP eligible on that basis. This area has not been systematically surveyed for archaeological resources. Because the area is developed and disturbed, it is unlikely to contain NRHP-eligible archaeological resources. In compliance with the standing Programmatic Agreement, survey work would be conducted on all areas that would be affected by construction prior to ground-breaking activities. Recorded prehistoric resources at Pantex include lithic scatters, hunting/kill sites, and concentrations of fire-cracked rock and are located predominantly near the playas (PX MH 1981a:58). Historic sites are generally associated with farming, such as remains of homes and outbuildings, and World War II and Cold War Era structures. Resources such as these may occur on the land that would be disturbed during construction. Construction, but not operation, may have an effect on any identified resources.

DOE has initiated a public outreach program to involve Native American groups in decision-making related to land use and cultural resources. To date, none of the Native American tribes known to have traditional interest in Pantex lands have identified any sacred sites, ceremonial areas, or cemeteries in Zone 4. Additional consultation may identify some of these resources. Resources such as cemeteries could be affected by new construction. Operation could have an auditory or visual impact on sacred or ceremonial sites.

Important paleontological remains such as bison and camel bones have been found in other areas of the High Plains and it is possible that some may occur in lands to be disturbed by construction at Pantex. Operation would not affect paleontological resources.

Oak Ridge Reservation

This facility would be constructed at the intersection of Route 95 and Bear Creek Road. A portion of this area on both sides of Bear Creek Road was surveyed prior to construction of the proposed Exxon Nuclear Facility which was never built (OR UTN 1975a:ii). Some prehistoric sites were identified near the Clinch River, and the potential for sites along the smaller creeks exists. In addition, remains of a number of early 20th-century frame houses and mid-to-late 19th-century log houses and outbuildings are located within the project area. Some of

these resources may be affected by facility construction. Additional sites may occur on unsurveyed lands to be disturbed.

No Native American resources have been identified in the project area to date. Some may be identified during project-specific consultation. Native American resources such as cemeteries and traditionally used plant and animal species could be affected by construction. Operation may have an auditory or visual impact on sacred or ceremonial sites.

Some paleontological remains may be encountered on the acreage to be disturbed during construction but no fossil remains with high research value are known to occur at ORR. During operation, no additional ground disturbance is expected, so there would be no additional impact to resources.

Savannah River Site

The vitrification facility would be located on open space within F-Area. Portions of F-Area have been surveyed and contain sites potentially eligible for the NRHP. Site types known to occur at SRS include remains of prehistoric base camps, and lithic quarries and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by the proposed action. Operation would not have an additional impact on archaeological resources.

Some Native American resources may be affected by the proposed action. Resources such as prehistoric sites, cemeteries, and traditional plants could be affected by construction. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to these areas may also result from the proposed alternative. These resources would be identified through consultation with the potentially affected tribes.

Some paleontological remains may occur on this acreage, but impacts would be considered negligible because the fossil assemblages known to occur at SRS are of low research value. During operation, no additional ground disturbance would be expected, so there would be no additional impact to resources.

| [Text deleted.]

4.3.4.1.8 Socioeconomics

This section analyzes the socioeconomic effects of the vitrification facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. Socioeconomic impacts attributable to construction would be reduced if existing facilities are used for part of the vitrification operation. The effects at all of the candidate sites are found in the supplemental socioeconomic Data Report (Socio 1996a).

Regional Economy Characteristics. Constructing a vitrification facility at any of the sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 382 workers in the peak year of construction at any site. The largest increases in regional employment (less than 1 percent) and regional per capita income (much less than 1 percent) among the sites analyzed would be at INEL. A total of 776 new jobs (382 direct and 394 indirect) would be generated and regional unemployment would fall from 5.4 percent to 4.9 percent (Socio 1996a).

Operating the facility would generate greater socioeconomic changes than would construction, due to the larger, more permanent workforce. A workforce of 768 would be required for full operation at any site. Implementing the alternative at INEL would generate the largest increases in regional employment (almost 2 percent) and per capita income (less than 1 percent). A total of 2,828 new jobs (768 direct and 2,060 indirect) would be generated by the operational activities and regional unemployment would fall to 4.0 percent (Socio 1996a).

Population and Housing. At all of the sites analyzed, construction employment requirements would be met by the available resident labor force, but some in-migrating workers would be needed to fill specialized positions during operation. Project-related increases in population would be greatest if the facility is located at Pantex. However, this increase would be less than 1 percent over No Action population projections. Housing units, in excess of existing vacancies, may be required at all of the sites analyzed, except NTS and ORR, to accommodate the in-migrating population during operation. The greatest increase in housing requirements would be in the INEL ROI but this would be much less than 1 percent over No Action estimates. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the population growth at all of the sites analyzed (Socio 1996a).

Community Services. During construction, there would be no increased demand for community services at any of the sites analyzed. However, operation of the facility would slightly increase the demand for community services at all sites analyzed. The effects of population growth due to in-migrating workers during construction or operations would be minor. The following discussion focuses on the Pantex ROI which is expected to experience the largest increase in demand for community services.

To maintain the No Action student-to-teacher ratio of 16.3:1 in the Pantex ROI, 15 new teachers would be needed during operation of the proposed facility. However, the increase in teacher requirements would be distributed over several school districts in the ROI, and no single school district would be significantly affected (Socio 1996a).

Only three additional police officers and three firefighters would need to be added in the Pantex ROI to maintain No Action service levels of 2.3 police officers and 2.3 firefighters per 1,000 persons (Socio 1996a).

Projected hospital occupancy rates would increase slightly over No Action estimates. However, projected hospital capacities would be capable of accommodating the small increase in patient load. To maintain the No Action service level of 2.0 physicians per 1,000 persons, only 2 additional physicians would be needed in the Pantex ROI (Socio 1996a).

Local Transportation. Traffic generated during the construction of the vitrification facility would not affect the level of service on the local road segments analyzed at any of the sites. However traffic would have the greatest

| effect on local transportation at INEL. U.S. 20/26 from U.S. 26 East to Idaho State Route 22/33 would experience a drop in level of service from B to C (Socio 1996a).

4.3.4.1.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the vitrification facility. The section first describes the impacts from normal facility operation at each potential site followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation during the assumed 10-year campaign time are presented in Tables 4.3.4.1.9-1 and 4.3.4.1.9-2, respectively, are presented in the text. Impacts from hazardous chemicals to these same groups are given in Table 4.3.4.1.9-3. Summaries of impacts associated with postulated accidents are given in Table 4.3.4.1.9-4 through 4.3.4.1.9-9. Detailed results are presented in Section M. For the Preferred Alternative, the duration would be reduced to 3.5 years and the risk and fatalities would also be reduced proportionally. The vitrification facility would be collocated with the Pu conversion facility under the Preferred Alternative but are analyzed separately in this PEIS.

The DOE's Preferred Alternative for Pu disposition includes the use of vitrification or immobilization technologies for the disposition of Pu in existing reactors. As a result of implementing a multiple technology disposition strategy for analysis purposes, approximately 30 percent of the surplus Pu would be vitrified or immobilized. Summaries of the radiological and hazardous chemical impacts to the public and to workers associated with normal operations and with postulated accidents are presented for an assumed 10-year operational campaign for the disposition of 50 t (55.1 tons) of Pu and for an assumed 3.5-year operational campaign for the Preferred Alternative. The impacts and risks associated with the Preferred Alternative would be reduced due to a shorter period of operations. It should also be noted that a Pu conversion facility may be collocated with the vitrification or immobilized facility. Impacts attributed to the Pu conversion facility are described in Section 4.3.2.9 for 10 years of operation.

Normal Operation. There would be no radiological releases associated with the construction of a vitrification facility at any of the sites analyzed. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained ALARA. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. If existing facilities are used, the hazardous chemical releases would be reduced. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the vitrification facility at each of the sites are presented in Table 4.3.4.1.9-1. The impacts from all site operations, including the vitrification facility, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The doses to the maximally exposed member of the public from annual vitrification facility operation range from 7.2×10^{-6} mrem at the NTS site to 2.5×10^{-4} mrem at the ORR site. From 10 years of operation, the corresponding risks of fatal cancer to this individual would range from 3.6×10^{-11} to 1.3×10^{-9} . The impacts to the average individual would be less. As a result of annual operations, the population doses would range from 1.4×10^{-5} person-rem at the NTS site to 5.0×10^{-3} person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 7.0×10^{-8} to 2.5×10^{-5} .

The dose to the maximally exposed member of the public from annual total site operations is within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would range

Table 4.3.4.1.9-1. Potential Radiological Impacts to the Public During Normal Operation of the
Vitrification Alternative

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility	Total Site ^a	Facility	Total Site ^a	Facility	Total Site ^a	Facility	Total Site ^a	Facility	Total Site ^a	Facility	Total Site ^a
Annual Dose to the Maximally Exposed Individual Member of the Public^b												
Atmospheric release pathway (mrem)	1.4x10 ⁻⁵	4.4x10 ⁻³	7.2x10 ⁻⁶	4.2x10 ⁻³	8.9x10 ⁻⁶	0.018	1.1x10 ⁻⁴	1.3x10 ⁻⁴	2.5x10 ⁻⁴	1.5	7.7x10 ⁻⁵	0.42
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0	0	0.10	0	0.081
Total liquid release pathway (mrem)	0	9.5x10 ⁻⁴	0	0	0	0	0	0	0	1.7	0	0.37
Atmospheric and liquid release pathways combined (mrem)	1.4x10 ⁻⁵	5.3x10 ⁻³	7.2x10 ⁻⁶	4.2x10 ⁻³	8.9x10 ⁻⁶	0.018	1.1x10 ⁻⁴	1.3x10 ⁻⁴	2.5x10 ⁻⁴	3.2	7.7x10 ⁻⁵	0.79
Percent of natural background ^c	4.7x10 ⁻⁶	1.8x10 ⁻³	2.3x10 ⁻⁶	1.3x10 ⁻³	2.6x10 ⁻⁶	5.2x10 ⁻³	3.3x10 ⁻⁵	3.9x10 ⁻⁵	8.5x10 ⁻⁵	1.1	2.6x10 ⁻⁵	0.27
10-year fatal cancer risk	7.0x10 ⁻¹¹	2.7x10 ⁻⁸	3.6x10 ⁻¹¹	2.1x10 ⁻⁸	4.5x10 ⁻¹¹	8.8x10 ⁻⁸	5.5x10 ⁻¹⁰	6.4x10 ⁻¹⁰	1.3x10 ⁻⁹	1.6x10 ⁻⁵	3.9 x10 ⁻¹⁰	4.0x10 ⁻⁶
3.5-year fatal cancer risk ^d	2.5x10 ⁻¹¹	9.5x10 ⁻⁹	1.3x10 ⁻¹¹	7.4x10 ⁻⁹	1.6x10 ⁻¹¹	3.1x10 ⁻⁸	1.9x10 ⁻¹⁰	2.2x10 ⁻¹⁰	4.6x10 ⁻¹⁰	5.6x10 ⁻⁶	1.4x10 ⁻¹⁰	1.4x10 ⁻⁶
Annual Population Dose Within 80 Kilometers^e												
Atmospheric release pathway (person-rem)	7.9x10 ⁻⁴	0.46	1.4x10 ⁻⁵	3.7x10 ⁻³	1.6x10 ⁻⁴	2.4	3.4x10 ⁻⁴	6.2x10 ⁻⁴	4.4x10 ⁻³	29	5.0x10 ⁻³	40
Total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	4.7	0	3.6
Atmospheric and liquid release pathways combined (person-rem)	7.9x10 ⁻⁴	1.6	1.4x10 ⁻⁵	3.7x10 ⁻³	1.6x10 ⁻⁴	2.4	3.4x10 ⁻⁴	6.2x10 ⁻⁴	4.4x10 ⁻³	34	5.0x10 ⁻³	44
Percent of natural background ^c	4.2x10 ⁻⁷	8.4x10 ⁻⁴	1.5x10 ⁻⁷	4.1x10 ⁻⁵	1.8x10 ⁻⁷	2.7x10 ⁻³	2.9x10 ⁻⁷	5.3x10 ⁻⁷	1.2x10 ⁻⁶	9.0x10 ⁻³	1.9x10 ⁻⁶	0.017
10-year fatal cancers	4.0x10 ⁻⁶	7.8x10 ⁻³	7.0x10 ⁻⁸	1.9x10 ⁻⁵	8.0x10 ⁻⁷	0.012	1.7x10 ⁻⁶	3.1x10 ⁻⁶	2.2x10 ⁻⁵	0.17	2.5x10 ⁻⁵	0.22
3.5-year fatal cancers ^d	1.4x10 ⁻⁶	2.7x10 ⁻³	2.5x10 ⁻⁸	6.7x10 ⁻⁶	2.8x10 ⁻⁷	4.2x10 ⁻³	6.0x10 ⁻⁷	1.1x10 ⁻⁶	7.7x10 ⁻⁶	0.060	8.8x10 ⁻⁶	0.077

Table 4.3.4.1.9-1. Potential Radiological Impacts to the Public During Normal Operation of the Vitrification Alternative—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Total		Total		Total		Total		Total		Total	
	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a
Annual Dose to the Average Individual Within 80 Kilometers^f												
Atmospheric and liquid release pathways combined (mrem)	1.3x10 ⁻⁶	2.6x10 ⁻³	4.8x10 ⁻⁷	1.3x10 ⁻⁴	5.9x10 ⁻⁷	8.9x10 ⁻⁷	9.7x10 ⁻⁷	1.8x10 ⁻⁶	3.4x10 ⁻⁶	0.026	5.6x10 ⁻⁶	0.049
10-year fatal cancer risk	6.4x10 ⁻¹²	1.3x10 ⁻⁸	2.4x10 ⁻¹²	6.3x10 ⁻¹⁰	3.0x10 ⁻¹²	4.5x10 ⁻⁸	4.9x10 ⁻¹²	8.9x10 ⁻¹²	1.7x10 ⁻¹¹	1.3x10 ⁻⁷	2.8x10 ⁻¹¹	2.5x10 ⁻⁷
3.5-year fatal cancer risk ^d	2.2x10 ⁻¹²	4.6x10 ⁻⁹	8.4x10 ⁻¹³	2.2x10 ⁻¹⁰	1.1x10 ⁻¹²	1.6x10 ⁻⁸	1.7x10 ⁻¹²	3.1x10 ⁻¹²	6.0x10 ⁻¹²	4.6x10 ⁻⁸	9.8x10 ⁻¹²	8.8x10 ⁻⁸

^a Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9). The location of the maximally exposed individual may be different under No Action than for operation of the vitrification facility. Therefore, the impacts may not be directly additive.

^b The applicable radiological limits for an individual member of the public from site operations are 10 mrem per year from the air pathways, as required by the NESHAPs (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

^c The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem; the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem; the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem; the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem; the population within 80 km receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem; the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem; the population within 80 km receives 266,000 person-rem.

^d For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies; the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionally reduced to a 3.5-year campaign.

^e For DOE activities proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

^f Obtained by dividing the population dose by the number of people projected to be living within 80 km of the site (621,000 at Hanford, 29,400 at NTS, 269,000 at INEL, 350,000 at Pantex, 1,285,000 at ORR, and 893,000 at SRS.)

Source: Section M.2.

from 1.3×10^{-4} mrem at Pantex to 3.2 mrem at the ORR site. From 10 years of operation, the corresponding risk of fatal cancer to this individual would range from 6.4×10^{-10} to 1.6×10^{-5} . The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operations, the population doses would be within the limit in proposed 10 CFR 834, and would range from 6.2×10^{-4} person-rem at Pantex to 44 person-rem at the SRS site. The corresponding number of fatal cancers in these populations from 10 years of operation would be range from 3.1×10^{-6} to 0.22. The disposition of approximately 30 percent of Pu using vitrification or immobilization technologies would decrease the operational campaign length. As a result, the impacts projected in this table for 50 t (55.1 tons) for the assumed 10-year campaign would be proportionately reduced.

Doses to onsite workers from normal operations are given in Table 4.3.4.1.9–2. Included are involved workers directly associated with the vitrification facility, workers who are not involved with the vitrification facility, and the entire workforce at each site. All doses fall within regulatory limits.

The annual dose to vitrification facility workers is site-independent and would be 200 mrem to the average facility worker and 110 person-rem to the entire facility workforce. The annual dose to the noninvolved worker would range from 2.6 mrem at the ORR site to 32 mrem at the SRS site. The annual total dose to all noninvolved workers would range from 3.0 person-rem at the NTS site to 250 person-rem at Hanford. The annual dose to the total site workforce would range from 113-person-rem at the NTS site to 360 person-rem at the Hanford site. The risks and numbers of fatal cancer among the different workers from 10 years of operation are included in Table 4.3.4.1.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also worker rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public resulting from normal operation of the vitrification facility at each of several sites are presented in Table 4.3.4.1.9–3. Included is the impact due only to operation of the vitrification facility and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI ranges from 1.0×10^{-4} at the NTS site to 3.9×10^{-3} at the ORR site due to the new facility operation. The cancer risk from hazardous chemicals to the MEI is zero (because no carcinogens are released from hazardous chemicals) at all sites. The HI to the onsite worker ranges from 0.019 at the Pantex site to 0.040 at ORR, and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals) at all sites. [Text deleted.]

Facility Accidents. A set of potential accidents has been postulated for the vitrification facility, where releases of Pu may occur that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and general population located within 80 km (50 mi) of the accident release point are summarized in Table 4.3.4.1.9–4 through 4.3.4.1.9–9 for the sites analyzed (Hanford, NTS, INEL, Pantex, ORR, and SRS). In the event that the site boundary is less than 1,000 m from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 9.9×10^{-3} at ORR for the Cs fire accident scenario with a probability of 1.0×10^{-6} per year. The corresponding 10 year cancer facility lifetime risk from the same accident scenarios for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 9.9×10^{-8} , 7.7×10^{-11} and 3.8×10^{-10} , respectively. The maximum population 10-year facility lifetime risk would be 1.8×10^{-5} (that is, one fatality in over 600,000 years) at ORR for the Cs ion processing fire accident scenario with a probability of 1.0×10^{-6} per year. The corresponding maximum offsite individual and worker 10 year facility lifetime risks would be 1.4×10^{-8} and 6.8×10^{-8} , respectively. The disposition of approximately 30 percent of Pu using vitrification or immobilization technologies would decrease the operational campaign length. As a result, the impacts projected for 50 t (55.1 tons) for the assumed 10-year campaign would be proportionally reduced.

Table 4.3.4.1.9-2. Potential Radiological Impacts to Workers During Normal Operation of the Vitrification Alternative

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce^a						
Average worker dose (mrem/yr) ^b	200	200	200	200	200	200
10-year risk of fatal cancer	8.0x10 ⁻⁴	8.0x10 ⁻⁴	8.0x10 ⁻⁴	8.0x10 ⁻⁴	8.0x10 ⁻⁴	8.0x10 ⁻⁴
3.5-year risk of fatal cancer ^c	2.8x10 ⁻⁴	2.8x10 ⁻⁴	2.8x10 ⁻⁴	2.8x10 ⁻⁴	2.8x10 ⁻⁴	2.8x10 ⁻⁴
Total dose (person-rem/yr)	110	110	110	110	110	110
10-year fatal cancers	0.44	0.44	0.44	0.44	0.44	0.44
3.5-year risk of fatal cancer ^c	0.15	0.15	0.15	0.15	0.15	0.15
Noninvolved Workforce^d						
Average worker dose (mrem/yr) ^b	27	5.0	30	10	2.6	32
10-year risk of fatal cancer	1.1x10 ⁻⁴	2.0x10 ⁻⁵	1.2x10 ⁻⁴	4.0x10 ⁻⁵	1.0x10 ⁻⁵	1.3x10 ⁻⁴
3.5-year risk of fatal cancer ^c	3.9x10 ⁻⁵	7.0x10 ⁻⁶	4.2x10 ⁻⁵	1.4x10 ⁻⁵	3.5x10 ⁻⁶	4.6x10 ⁻⁵
Total dose (person-rem/yr)	250	3.0	220	14	44	226
10-year fatal cancers	1.0	0.012	0.88	0.056	0.18	0.90
3.5 year fatal cancers ^c	0.35	4.2x10 ⁻³	0.31	0.020	0.063	0.32
Total Site Workforce^e						
Dose (person-rem/yr)	360	113	330	124	154	336
10-year fatal cancers	1.4	0.45	1.3	0.50	0.62	1.3
3.5 year fatal cancers ^c	0.49	0.16	0.46	0.18	0.22	0.46

^a The involved worker is associated with operations of the vitrification facility.

^b The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992i); the sites must make reasonable attempts to maintain worker doses below this level.

^c For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies, the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionally reduced to a 3.5-year campaign.

^d The noninvolved worker is onsite but not associated with operations of the vitrification facility. The Noninvolved Workforce is equivalent to the No Action workforce.

^e The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

Table 4.3.4.1.9-3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the
Vitrification Alternative

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^b	Total Site ^c	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b
Maximally Exposed Individual (Public)												
Hazard Index ^c	6.7x10 ⁻⁴	7.3x10 ⁻⁴	1.0x10 ⁻⁴	1.0x10 ⁻⁴	1.4x10 ⁻³	0.017	3.7x10 ⁻³	9.4x10 ⁻³	3.9x10 ⁻³	0.043	1.8x10 ⁻⁴	5.3x10 ⁻³
Cancer Risk ^d	0	0	0	0	0	3.6x10 ⁻⁶	0	1.1x10 ⁻⁸	0	0	0	1.3x10 ⁻⁷
Worker Onsite												
Hazard Index ^e	0.038	0.042	0.020	0.020	0.038	0.26	0.019	0.025	0.040	0.19	0.034	1.2
Cancer Risk ^f	0	0	0	0	0	7.7x10 ⁻⁴	0	4.5x10 ⁻⁷	0	0	0	1.9x10 ⁻⁴

^a Facility=Contribution from the proposed new facility operation only.

^b Total=Includes the contributions from the No Action and the proposed new facility operation.

^c Hazard Index for MEL=sum of individual Hazard Quotients (noncancer health effects) for MEL.

^d Cancer Risk for MEL=(Emissions concentration) x (0.286 [converts concentrations to doses]) x (Slope Factor).

^e Hazard Index for workers=sum of individual Hazard Quotients (noncancer health effects) for workers.

^f Cancer Risk for workers=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (Slope Factor).

Where there are no known carcinogens among chemicals emitted, there are no Slope Factors, therefore the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4-48 through M.3.4-53.

Table 4.3.4.1.9–4. *Vitrification Alternative Accident Impacts at Hanford Site*

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c	
Blender spill	9.1x10 ⁻¹⁰ (3.2x10 ⁻¹⁰)	1.8x10 ⁻⁹	8.6x10 ⁻¹² (3.0x10 ⁻¹²)	1.7x10 ⁻¹¹	7.6x10 ⁻⁸ (2.7x10 ⁻⁸)	1.5x10 ⁻⁷	0.05
Melter spill	9.1x10 ⁻¹³ (3.2x10 ⁻¹³)	9.1x10 ⁻¹⁰	8.6x10 ⁻¹⁵ (3.0x10 ⁻¹⁵)	8.6x10 ⁻¹³	7.6x10 ⁻¹¹ (2.7x10 ⁻¹¹)	7.6x10 ⁻⁹	1.0x10 ⁻³
Cs capsule drop	5.3x10 ⁻¹² (1.8x10 ⁻¹²)	5.3x10 ⁻¹¹	4.0x10 ⁻¹⁴ (1.4x10 ⁻¹⁴)	4.0x10 ⁻¹²	6.4x10 ⁻¹⁰ (2.2x10 ⁻¹⁰)	6.4x10 ⁻⁸	1.0x10 ⁻³
Canister drop	9.0x10 ⁻¹² (3.1x10 ⁻¹²)	9.0x10 ⁻¹⁰	8.5x10 ⁻¹⁴ (3.0x10 ⁻¹⁴)	8.5x10 ⁻¹²	7.5x10 ⁻¹⁰ (2.6x10 ⁻¹⁰)	7.5x10 ⁻⁸	1.0x10 ⁻³
CPC ion column fire	6.9x10 ⁻⁸ (2.4x10 ⁻⁸)	6.9x10 ⁻⁶	5.3x10 ⁻¹⁰ (1.9x10 ⁻¹⁰)	5.3x10 ⁻⁸	8.4x10 ⁻⁶ (2.9x10 ⁻⁶)	8.4x10 ⁻⁴	1.0x10 ⁻³
Pu oxide oven solids fire	1.7x10 ⁻¹⁴ (5.9x10 ⁻¹⁵)	1.7x10 ⁻¹²	1.7x10 ⁻¹⁶ (6.0x10 ⁻¹⁷)	1.7x10 ⁻¹⁴	1.2x10 ⁻¹³ (4.2x10 ⁻¹¹)	1.2x10 ⁻¹⁰	1.0x10 ⁻³
Earthquake	4.4x10 ⁻¹² (1.5x10 ⁻¹²)	4.4x10 ⁻⁸	4.4x10 ⁻¹⁴ (1.5x10 ⁻¹⁴)	4.4x10 ⁻¹⁰	3.2x10 ⁻¹⁰ (1.1x10 ⁻¹⁰)	3.2x10 ⁻⁶	1.0x10 ⁻⁵ 1.0x10 ⁻⁵
Cs fire	3.9x10 ⁻¹⁰ (1.4x10 ⁻¹⁰)	3.9x10 ⁻⁵	3.0x10 ⁻¹² (1.0x10 ⁻¹²)	3.0x10 ⁻⁷	4.7x10 ⁻⁸ (1.6x10 ⁻⁸)	4.7x10 ⁻³	1.0x10 ⁻⁶ 1.0x10 ⁻⁶
Blender fire	7.0x10 ⁻¹¹ (2.5x10 ⁻¹¹)	7.0x10 ⁻⁶	5.3x10 ⁻¹³ (1.9x10 ⁻¹³)	5.3x10 ⁻⁸	8.4x10 ⁻⁹ (2.9x10 ⁻⁹)	8.4x10 ⁻⁴	1.0x10 ⁻⁶ 1.0x10 ⁻⁶
Nuclear criticality in Pu oxide furnace	4.2x10 ⁻¹² (1.5x10 ⁻¹²)	4.2x10 ⁻⁷	3.3x10 ⁻¹⁴ (1.2x10 ⁻¹⁴)	3.3x10 ⁻⁹	3.5x10 ⁻¹¹ (1.2x10 ⁻¹¹)	3.5x10 ⁻⁶	1.0x10 ⁻⁶
Expected risk ^d	7.1x10 ⁻⁸ (2.5x10 ⁻⁸)	–	5.4x10 ⁻¹⁰ (1.9x10 ⁻¹⁰)	–	8.5x10 ⁻⁶ (3.0x10 ⁻⁶)	–	–

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table 4.3.4.1.9–5. Vitrification Alternative Accident Impacts at Nevada Test Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c	
Blender spill	6.2x10 ⁻¹⁰ (2.2x10 ⁻¹⁰)	1.2x10 ⁻⁹	1.4x10 ⁻¹¹ (4.9x10 ⁻¹²)	2.7x10 ⁻¹¹	1.7x10 ⁻⁹ (5.9x10 ⁻¹⁰)	3.5x10 ⁻⁹	0.05
Melter spill	6.2x10 ⁻¹³ (2.2x10 ⁻¹³)	6.2x10 ⁻¹¹	1.4x10 ⁻¹⁴ (4.9x10 ⁻¹⁵)	1.4x10 ⁻¹²	1.7x10 ⁻¹² (5.9x10 ⁻¹³)	1.7x10 ⁻¹⁰	1.0x10 ⁻³
Cs capsule drop	3.6x10 ⁻¹² (1.3x10 ⁻¹²)	3.6x10 ⁻¹⁰	6.6x10 ⁻¹⁴ (2.3x10 ⁻¹⁴)	6.6x10 ⁻¹²	1.5x10 ⁻¹¹ (5.2x10 ⁻¹²)	1.5x10 ⁻⁹	1.0x10 ⁻³
Canister drop	6.1x10 ⁻¹² (2.1x10 ⁻¹²)	6.1x10 ⁻¹⁰	1.4x10 ⁻¹³ (4.9x10 ⁻¹⁴)	1.4x10 ⁻¹¹	1.7x10 ⁻¹¹ (5.9x10 ⁻¹²)	1.7x10 ⁻⁹	1.0x10 ⁻³
CPC ion column fire	4.7x10 ⁻⁸ (1.6x10 ⁻⁸)	4.7x10 ⁻⁶	8.7x10 ⁻¹⁰ (3.0x10 ⁻¹⁰)	8.7x10 ⁻⁸	1.9x10 ⁻⁷ (6.6x10 ⁻⁸)	1.9x10 ⁻⁵	1.0x10 ⁻³
Pu oxide oven solids fire	1.2x10 ⁻¹⁴ (4.2x10 ⁻¹⁵)	1.1x10 ⁻¹²	2.7x10 ⁻¹⁶ (9.4x10 ⁻¹⁷)	2.7x10 ⁻¹⁴	2.8x10 ⁻¹⁴ (9.8x10 ⁻¹⁵)	2.8x10 ⁻¹²	1.0x10 ⁻³
Earthquake	3.0x10 ⁻¹² (1.0x10 ⁻¹²)	3.0x10 ⁻⁸	7.0x10 ⁻¹⁴ (2.4x10 ⁻¹⁴)	7.0x10 ⁻¹⁰	7.2x10 ⁻¹² (2.5x10 ⁻¹²)	7.2x10 ⁻⁸	1.0x10 ⁻⁵
Cs fire	2.6x10 ⁻¹⁰ (9.1x10 ⁻¹¹)	2.6x10 ⁻⁵	4.9x10 ⁻¹² (1.7x10 ⁻¹²)	4.9x10 ⁻⁷	1.1x10 ⁻⁹ (3.8x10 ⁻¹⁰)	1.1x10 ⁻⁴	1.0x10 ⁻⁶
Blender fire	4.7x10 ⁻¹¹ (1.6x10 ⁻¹¹)	4.7x10 ⁻⁶	8.7x10 ⁻¹³ (2.3x10 ⁻¹⁴)	8.7x10 ⁻⁸	2.0x10 ⁻¹⁰ (7.0x10 ⁻¹¹)	2.0x10 ⁻⁵	1.0x10 ⁻⁶
Nuclear criticality in Pu oxide furnace	3.1x10 ⁻¹² (1.1x10 ⁻¹²)	3.1x10 ⁻⁷	6.5x10 ⁻¹⁴ (2.3x10 ⁻¹⁴)	6.5x10 ⁻⁹	6.9x10 ⁻¹³ (2.4x10 ⁻¹³)	6.9x10 ⁻⁸	1.0x10 ⁻⁶
Expected risk ^d	4.8x10 ⁻⁸ (1.7x10 ⁻⁸)	–	8.9x10 ⁻¹⁰ (3.1x10 ⁻¹⁰)	–	2.0x10 ⁻⁷ (7.0x10 ⁻⁸)	–	–

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table 4.3.4.1.9–6. Vitrification Alternative Accident Impacts at Idaho National Engineering Laboratory

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c	
Blender spill	8.4×10^{-10} (2.9×10^{-10})	1.7×10^{-9}	8.6×10^{-12} (3.0×10^{-12})	1.7×10^{-11}	2.3×10^{-8} (8.0×10^{-9})	4.7×10^{-8}	0.05
Melter spill	8.4×10^{-13} (2.9×10^{-13})	8.4×10^{-11}	8.7×10^{-15} (3.0×10^{-15})	8.7×10^{-13}	2.3×10^{-11} (8.0×10^{-12})	2.3×10^{-9}	1.0×10^{-3}
Cs capsule drop	4.6×10^{-12} (1.6×10^{-12})	4.6×10^{-10}	3.8×10^{-14} (1.3×10^{-14})	3.8×10^{-12}	2.0×10^{-10} (7.0×10^{-11})	2.0×10^{-8}	1.0×10^{-3}
Canister drop	8.3×10^{-12} (2.9×10^{-12})	8.3×10^{-10}	8.5×10^{-14} (3.0×10^{-14})	8.5×10^{-12}	2.3×10^{-10} (8.0×10^{-11})	2.3×10^{-8}	1.0×10^{-3}
CPC ion column fire	6.1×10^{-8} (2.1×10^{-8})	6.1×10^{-6}	5.0×10^{-10} (1.7×10^{-10})	5.0×10^{-8}	2.6×10^{-6} (9.1×10^{-7})	2.6×10^{-4}	1.0×10^{-3}
Pu oxide oven solids fire	1.6×10^{-14} (5.6×10^{-15})	1.6×10^{-12}	1.7×10^{-16} (5.9×10^{-17})	1.7×10^{-14}	3.7×10^{-13} (1.3×10^{-13})	3.7×10^{-11}	1.0×10^{-3}
Earthquake	4.1×10^{-12} (1.4×10^{-12})	4.1×10^{-8}	4.4×10^{-14} (1.5×10^{-14})	4.4×10^{-10}	9.6×10^{-11} (3.3×10^{-11})	9.6×10^{-7}	1.0×10^{-5}
Cs fire	3.4×10^{-10} (1.2×10^{-10})	3.4×10^{-5}	2.9×10^{-12} (1.0×10^{-12})	2.9×10^{-7}	1.5×10^{-8} (5.2×10^{-9})	1.5×10^{-3}	1.0×10^{-6}
Blender fire	6.1×10^{-11} (2.1×10^{-11})	6.1×10^{-6}	5.1×10^{-13} (1.8×10^{-13})	5.1×10^{-8}	2.7×10^{-9} (9.4×10^{-10})	2.7×10^{-4}	1.0×10^{-6}
Nuclear criticality in Pu oxide furnace	4.0×10^{-12} (1.4×10^{-12})	4.0×10^{-7}	3.9×10^{-14} (1.4×10^{-14})	3.9×10^{-9}	9.0×10^{-12} (3.1×10^{-12})	9.0×10^{-7}	1.0×10^{-6}
Expected risk ^d	6.2×10^{-8} (2.2×10^{-8})	–	5.2×10^{-10} (1.8×10^{-10})	–	2.7×10^{-6} (9.4×10^{-7})	–	–

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table 4.3.4.1.9–7. Vittrification Alternative Accident Impacts at Pantex Plant

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c	
Blender spill	3.7x10 ⁻¹⁰ (1.3x10 ⁻¹⁰)	7.5x10 ⁻¹⁰	1.1x10 ⁻¹⁰ (3.8x10 ⁻¹¹)	2.1x10 ⁻¹⁰	2.5x10 ⁻⁸ (8.7x10 ⁻⁹)	5.0x10 ⁻⁸	0.05
Melter spill	3.7x10 ⁻¹³ (1.3x10 ⁻¹³)	3.7x10 ⁻¹¹	1.0x10 ⁻¹³ (3.5x10 ⁻¹⁴)	1.0x10 ⁻¹¹	2.5x10 ⁻¹¹ (8.7x10 ⁻¹²)	2.5x10 ⁻⁹	1.0x10 ⁻³
Cs capsule drop	2.2x10 ⁻¹² (7.7x10 ⁻¹³)	2.2x10 ⁻¹⁰	5.9x10 ⁻¹³ (2.1x10 ⁻¹³)	5.9x10 ⁻¹¹	1.9x10 ⁻¹⁰ (6.6x10 ⁻¹¹)	1.9x10 ⁻⁸	1.0x10 ⁻³
Canister drop	3.7x10 ⁻¹² (1.3x10 ⁻¹²)	3.7x10 ⁻¹⁰	1.0x10 ⁻¹² (3.5x10 ⁻¹³)	1.0x10 ⁻¹⁰	2.5x10 ⁻¹⁰ (8.7x10 ⁻¹¹)	2.5x10 ⁻⁸	1.0x10 ⁻³
CPC ion column fire	3.0x10 ⁻⁸ (1.0x10 ⁻⁸)	3.0x10 ⁻⁶	7.7x10 ⁻⁹ (2.7x10 ⁻⁹)	7.7x10 ⁻⁷	2.5x10 ⁻⁶ (8.7x10 ⁻⁷)	2.5x10 ⁻⁴	1.0x10 ⁻³
Pu oxide oven solids fire	6.9x10 ⁻¹⁵ (2.4x10 ⁻¹⁵)	6.9x10 ⁻¹³	2.0x10 ⁻¹⁵ (7.0x10 ⁻¹⁶)	2.0x10 ⁻¹³	4.2x10 ⁻¹³ (1.5x10 ⁻¹³)	4.2x10 ⁻¹¹	1.0x10 ⁻³
Earthquake	1.8x10 ⁻¹² (6.3x10 ⁻¹³)	1.8x10 ⁻⁸	5.1x10 ⁻¹³ (1.8x10 ⁻¹³)	5.1x10 ⁻⁹	1.1x10 ⁻¹⁰ (3.8x10 ⁻¹¹)	1.1x10 ⁻⁶	1.0x10 ⁻⁵
Cs fire	1.7x10 ⁻¹⁰ (5.9x10 ⁻¹¹)	1.7x10 ⁻⁵	4.4x10 ⁻¹¹ (1.5x10 ⁻¹¹)	4.4x10 ⁻⁶	1.4x10 ⁻⁸ (4.9x10 ⁻⁹)	1.4x10 ⁻³	1.0x10 ⁻⁶
Blender fire	3.0x10 ⁻¹¹ (1.0x10 ⁻¹¹)	3.0x10 ⁻⁶	7.8x10 ⁻¹² (2.7x10 ⁻¹²)	7.8x10 ⁻⁷	2.5x10 ⁻⁹ (8.7x10 ⁻¹⁰)	2.5x10 ⁻⁴	1.0x10 ⁻⁶
Nuclear criticality in Pu oxide furnace	1.9x10 ⁻¹² (6.6x10 ⁻¹³)	1.9x10 ⁻⁷	7.0x10 ⁻¹³ (2.4x10 ⁻¹³)	7.0x10 ⁻⁸	2.2x10 ⁻¹¹ (7.7x10 ⁻¹²)	2.2x10 ⁻⁶	1.0x10 ⁻⁶
Expected risk ^d	3.0x10 ⁻⁸ (1.0x10 ⁻⁸)	–	7.9x10 ⁻⁹ (7.8x10 ⁻⁹)	–	2.6x10 ⁻⁶ (9.1x10 ⁻⁷)	–	–

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table 4.3.4.1.9–8. Vitrification Alternative Accident Impacts at Oak Ridge Reservation

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c	
Blender spill	8.5×10^{-10} (3.0×10^{-10})	1.7×10^{-9}	1.8×10^{-10} (6.3×10^{-11})	3.7×10^{-10}	1.8×10^{-7} (6.3×10^{-8})	3.5×10^{-7}	0.05
Melter spill	8.6×10^{-13} (3.0×10^{-13})	8.6×10^{-11}	1.8×10^{-13} (6.3×10^{-14})	1.8×10^{-11}	1.8×10^{-10} (6.3×10^{-11})	1.8×10^{-8}	1.0×10^{-3}
Cs capsule drop	5.2×10^{-12} (1.8×10^{-12})	5.2×10^{-10}	1.0×10^{-12} (3.5×10^{-13})	1.0×10^{-10}	1.3×10^{-9} (4.5×10^{-10})	1.3×10^{-7}	1.0×10^{-3}
Canister drop	8.4×10^{-12} (2.9×10^{-12})	8.4×10^{-10}	1.8×10^{-12} (6.3×10^{-13})	1.8×10^{-10}	1.7×10^{-9} (5.9×10^{-10})	1.7×10^{-7}	1.0×10^{-3}
CPC ion column fire	6.8×10^{-8} (2.4×10^{-8})	6.8×10^{-6}	1.4×10^{-8} (4.9×10^{-9})	1.4×10^{-6}	1.8×10^{-5} (6.3×10^{-6})	1.8×10^{-3}	1.0×10^{-3}
Pu oxide oven solids fire	1.6×10^{-14} (5.6×10^{-15})	1.6×10^{-12}	3.5×10^{-15} (1.2×10^{-15})	3.5×10^{-13}	3.0×10^{-12} (1.0×10^{-12})	3.0×10^{-10}	1.0×10^{-3}
Earthquake	4.1×10^{-12} (1.4×10^{-12})	4.1×10^{-8}	8.9×10^{-13} (3.1×10^{-13})	8.9×10^{-9}	7.7×10^{-10} (2.7×10^{-10})	7.7×10^{-6}	1.0×10^{-5}
Cs fire	3.8×10^{-10} (1.3×10^{-11})	3.8×10^{-5}	7.7×10^{-11} (2.7×10^{-11})	7.7×10^{-6}	9.9×10^{-8} (3.5×10^{-8})	9.9×10^{-3}	1.0×10^{-6}
Blender fire	6.8×10^{-11} (2.4×10^{-11})	6.8×10^{-6}	1.4×10^{-11} (4.9×10^{-12})	1.4×10^{-6}	1.8×10^{-8} (6.3×10^{-9})	1.8×10^{-3}	1.0×10^{-6}
Nuclear criticality in Pu oxide furnace	3.8×10^{-12} (1.3×10^{-12})	3.8×10^{-7}	8.5×10^{-13} (3.0×10^{-13})	8.5×10^{-8}	1.6×10^{-10} (5.6×10^{-11})	1.6×10^{-5}	1.0×10^{-6}
Expected risk ^d	6.9×10^{-8} (2.4×10^{-8})	—	1.4×10^{-8} (4.9×10^{-9})	—	1.8×10^{-5} (6.3×10^{-6})	—	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Table 4.3.4.1.9–9. Vitrification Alternative Accident Impacts at Savannah River Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c	
Blender spill	6.1x10 ⁻¹⁰ (2.1x10 ⁻¹⁰)	1.2x10 ⁻⁹	1.5x10 ⁻¹³ (5.2x10 ⁻¹⁴)	2.9x10 ⁻¹¹	8.0x10 ⁻⁸ (2.8x10 ⁻⁸)	1.6x10 ⁻⁷	0.05
Melter spill	6.1x10 ⁻¹³ (2.1x10 ⁻¹³)	6.1x10 ⁻¹¹	1.5x10 ⁻¹⁴ (5.2x10 ⁻¹⁵)	1.5x10 ⁻¹²	8.0x10 ⁻¹¹ (2.8x10 ⁻¹¹)	8.0x10 ⁻⁹	1.0x10 ⁻³
Cs capsule drop	3.7x10 ⁻¹² (1.3x10 ⁻¹²)	3.7x10 ⁻¹⁰	8.2x10 ⁻¹⁴ (2.9x10 ⁻¹⁴)	8.2x10 ⁻¹²	6.4x10 ⁻¹⁰ (2.2x10 ⁻¹⁰)	6.4x10 ⁻⁸	1.0x10 ⁻³
Canister drop	6.0x10 ⁻¹² (2.1x10 ⁻¹²)	6.0x10 ⁻¹⁰	1.4x10 ⁻¹³ (4.9x10 ⁻¹⁴)	1.4x10 ⁻¹¹	7.9x10 ⁻¹⁰ (2.8x10 ⁻¹⁰)	7.9x10 ⁻⁸	1.0x10 ⁻³
CPC ion column fire	4.8x10 ⁻⁸ (1.7x10 ⁻⁸)	4.8x10 ⁻⁶	1.1x10 ⁻⁹ (3.8x10 ⁻¹⁰)	1.1x10 ⁻⁷	8.4x10 ⁻⁶ (2.9x10 ⁻⁶)	8.4x10 ⁻⁴	1.0x10 ⁻³
Pu oxide oven solids fire	1.1x10 ⁻¹⁴ (3.8x10 ⁻¹⁵)	1.1x10 ⁻¹²	2.7x10 ⁻¹⁶ (9.4x10 ⁻¹⁷)	2.7x10 ⁻¹⁴	1.3x10 ⁻¹² (4.5x10 ⁻¹³)	1.3x10 ⁻¹⁰	1.0x10 ⁻³
Earthquake	2.9x10 ⁻¹² (1.0x10 ⁻¹²)	2.9x10 ⁻⁸	7.1x10 ⁻¹⁴ (2.5x10 ⁻¹⁴)	7.1x10 ⁻¹⁰	3.4x10 ⁻¹⁰ (1.2x10 ⁻¹⁰)	3.4x10 ⁻⁶	1.0x10 ⁻⁵
Cs fire	2.7x10 ⁻¹⁰ (9.4x10 ⁻¹¹)	2.7x10 ⁻⁵	6.1x10 ⁻¹² (2.1x10 ⁻¹²)	6.1x10 ⁻⁷	4.7x10 ⁻⁸ (1.6x10 ⁻⁸)	4.7x10 ⁻³	1.0x10 ⁻⁶
Blender fire	4.8x10 ⁻¹¹ (1.7x10 ⁻¹¹)	4.8x10 ⁻⁶	1.1x10 ⁻¹² (3.8x10 ⁻¹³)	1.1x10 ⁻⁷	8.4x10 ⁻⁹ (2.9x10 ⁻⁹)	8.4x10 ⁻⁴	1.0x10 ⁻⁶
Nuclear criticality in Pu oxide furnace	2.8x10 ⁻¹² (9.8x10 ⁻¹³)	2.8x10 ⁻⁷	5.7x10 ⁻¹⁴ (2.0x10 ⁻¹⁴)	5.7x10 ⁻⁹	4.7x10 ⁻¹¹ (1.6x10 ⁻¹¹)	4.7x10 ⁻⁶	1.0x10 ⁻⁶
Expected risk ^d	4.9x10 ⁻⁸ (1.7x10 ⁻⁸)	–	1.1x10 ⁻⁹ (3.8x10 ⁻¹⁰)	–	8.5x10 ⁻⁶ (3.0x10 ⁻⁶)	–	–

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.5.1–3 and M.5.3.5.1–4 and the MACCS computer code.

Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.4.1.9–4 through 4.3.4.1.9–9.

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details that affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Prior to construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas to minimize the risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new disposition facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is the possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

An indication of the magnitude of the impacts of an aircraft into a disposition facility is given by the earthquake scenario. The earthquake and aircraft crash scenarios are similar in that they both result in major structural damage and the release of Pu directly to the environment. They differ in that an earthquake-induced fire is based on limited combustible materials while the aircraft crash has the potential for a major fuel-related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive serious or fatal impacts.

4.3.4.1.10 Waste Management

This section summarizes the waste management impacts for the construction and operation of a vitrification facility. There is no spent nuclear fuel or HLW associated with the operation of the vitrification facility; however, the facility does generate as its product output a glass log. The vitrification facility would provide interim storage of the glass log until entry into the Federal Waste Management System for final disposition. Table 4.3.4.1.10-1 provides the estimated operational waste volumes projected to be generated at the sites analyzed as a result of the vitrification facility. Facilities that would support the vitrification facility would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS wastes could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated on-site to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the vitrification facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.4. A detailed description of the waste management activities that would be required to support the vitrification facility can also be found in Section E.3.3.4.

Construction and operation of a vitrification facility would impact existing waste management activities at each of the sites analyzed by increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Wastes generated during construction would consist of wastewater, and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any contaminated soil is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

Approximately 99 m³ (130 yd³) of solid TRU waste consisting of job-control waste (protective clothing and radiological survey waste), HEPA filters, resins, and sludge from liquid TRU waste treatment would require treatment and repackaging to meet the current planning-basis WIPP WAC or alternative treatment level. Hanford, INEL, and SRS have existing and planned TRU waste facilities that could be utilized. Due to their limited capability to process, package, and store TRU waste, a radwaste facility would need to be constructed as part of the vitrification facility if sited at ORR, Pantex, or NTS. A small quantity (0.7 m³ [0.9 yd³]) of solid mixed TRU waste would require treatment and packaging to meet the current planning-basis WIPP WAC or alternative treatment level. Mixed TRU waste would be generated if a TRU waste stream became contaminated with a hazardous waste constituent. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), 12 additional truck shipments per year or, if applicable, 6 regular train shipments per year or 2 dedicated train shipments per year would be required. [Text deleted.]

All of the sites analyzed have existing or planned facilities that could manage the small quantities of LLW. Following treatment and volume reduction, approximately 14 m³ (18 yd³) of LLW from solidified liquid LLW, protective clothing, soil, and small equipment would require disposal. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.004 ha/yr (0.01 acre/yr) at Hanford and ORR, 0.002 ha/yr (0.006 acre/yr) at NTS and INEL, and 0.002 ha/yr (0.004 acre/yr) at SRS. With no onsite LLW disposal capability, Pantex would require one additional LLW shipment per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

A small quantity (0.15 m³ [0.2 yd³]) of solid mixed LLW consisting of contaminated solvent rags and equipment that has been contaminated with both radioactive and hazardous constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the Tri-Party

Table 4.3.4.1.10–1. Estimated Annual Generated Waste Volumes for the Vitrification Alternative^a

Category	New Facility (m ³)	Hanford	NTS	INEL	Pantex	ORR	SRS
		No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)
Transuranic							
Liquid	0.8 ^b	None	None	None	None	None	None
Solid	99	271	None	3.5	None	119	338
Mixed Transuranic							
Liquid	0	None	None	None	None	None	None
Solid	0.7	98	None	Included in TRU	None	None	Included in TRU
Low-Level							
Liquid	7 ^b	None	Dependent on restoration activities	None	8	2,970	74,000
Solid	14	3,390	15,000	7,200	32	7,320	16,400
Mixed Low-Level							
Liquid	0	3,760	None	4	4	87,600	1,330
Solid	0.15	1,505	50	170	46	432	7,700
Hazardous							
Liquid	19	Included in solid	Included in solid	Included in solid	2	6,460	1,260
Solid	19	560	212	1,200	31	26	15,100
Nonhazardous (Sanitary)							
Liquid	34,000	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000
Solid	920	5,107	2,120	52,000	339	53,100	61,200
Nonhazardous (Other)							
Liquid	269,000	Included in sanitary	Included in sanitary	None	Included in sanitary	650,000	Included in sanitary
Solid	15 ^c	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary

^a The No Action volumes are from Tables 4.2.1.10–1, 4.2.2.10–1, 4.2.3.10–1, 4.2.4.10–1, 4.2.5.10–1, and 4.2.6.10–1. Incremental waste generation volumes for vitrification facility are from Table E.3.3.4–1. Waste effluent volumes (that is, after treatment and volume reduction) that are used in the narrative description of the impacts are also provided in Table E.3.3.4–1.

^b Liquid TRU and LLW would be treated and solidified prior to disposal.

^c Recyclable wastes.

Agreement for Hanford or the respective site treatment plan that was developed to comply with the *Federal Facility Compliance Act* for the remainder of the sites analyzed.

An estimated 19 m³ (5,000 gals) of liquid and 19 m³ (25 yd³) of solid hazardous wastes would be generated annually. Hazardous waste would consist primarily of analytical solutions and solvent rags contaminated with methylene chloride, acetonitrile, and acetone. Other hazardous wastes would include paint solvents, various laboratory chemicals, and organic waste from nonradioactive testing. Hazardous waste would be staged in RCRA-permitted facilities until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

Approximately 34,000 m³ (9 million gal) of liquid nonhazardous sanitary and industrial wastewater and 269,000 m³ (71 million gal) of steam plant blowdown, process wastewater, and estimated stormwater runoff would require treatment in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems may be required for some of the DOE sites. For the Preferred Alternative, construction of sanitary, utility, and process wastewater treatment systems may not be required because approximately 30 percent of the surplus Pu would be vitrified. The construction of these treatment systems would be determined in further tiered NEPA documentation. The 920 m³ (1,200 yd³) of solid nonhazardous waste such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

4.3.4.2 Ceramic Immobilization Alternative

The environmental impacts described in the following sections are based on the analysis of the ceramic immobilization facility described in Section 2.4.4.2. The highly radioactive isotope Cs-137, would be included into the ceramic matrix to serve as a radiation barrier to theft and diversion. The representative sites used for this facility are: Hanford, NTS, INEL, Pantex, ORR, and SRS.

In accordance with the Preferred Alternative for surplus Pu disposition, the ceramic immobilization facility could be located at either Hanford or SRS. Further tiered NEPA review will be conducted to examine alternative locations including new and existing facilities at these two sites, should the Preferred Alternative be selected at the ROD.

For the ceramic immobilization, the analysis in Section 4.3.4.2.1 to 4.3.4.2.10 assumes that a new facility would be built. However, there are several potential variations described in Table 2.4-1, some of which could potentially use existing facilities for portions of the operations. For example, under the can-in-canister approach, the existing DWPF at SRS could be used to provide vitrified glass for the outer canister which surrounds the inner can of immobilized Pu.

4.3.4.2.1 Land Resources

A new ceramic immobilization facility would disturb 20 ha (49 acres) of land during construction of which 12 ha (30 acres) is used during operations. The need for buffer zones would be determined during site-specific, tiered NEPA documentation. This section describes the impacts to land resources from construction and operation of the facility for each representative site. Land use would be less if existing facilities were used for portions of the ceramic immobilization operation.

Construction and operation of the ceramic immobilization facility would not cause indirect land-use impacts at the analysis sites. As discussed in Section 4.3.4.2.8, in-migration of workers would be required during construction at INEL and Pantex and at all sites analyzed during operations. It is expected that historic housing construction rates would be sufficient to accommodate the in-migrating population at each site. Therefore, offsite land use at the analysis sites would not be affected.

Hanford Site

Land Use. The potential site for a new ceramic immobilization facility would utilize vacant land in the 200 Area adjacent to 200 East. Construction and operation of the ceramic immobilization alternative would be in conformance with existing and future land use as described in the current *Hanford Site Development Plan* and with ongoing discussions in the comprehensive land use planning process. According to the *Hanford Site Development Plan*, 200 Area land use is identified as waste operations, which includes radioactive material management, processing, and storage (HF DOE 1993c:13,14). [Text deleted.]

Construction and operation would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. Construction and operation would be compatible with State and local (Benton, Franklin, and Grant counties and the city of Richland) land-use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction and operation would be consistent with the industrialized landscape character of the 200 Area and current VRM Class 5 designation. A potential source of visual impact during operations would be from the stack plumes which could be visible from public viewpoints with high sensitivity levels, including State Highways 24 and 240 and the city of Richland; however, because of the viewing distance and compatibility of the proposal with existing industrial character, visual impacts would not occur.

Nevada Test Site

Land Use. [Text deleted.] Construction and operation of the facility in Area 6 would not be in conformance with the current *Nevada Test Site Development Plan*, which designates the southeast area of NTS as a nonnuclear test area. [Text deleted.] However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as part of the NTS defense program material disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8,3-9; NT DOE 1996e:A-18). [Text deleted.]

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, and controls of adjacent jurisdictions since none of these counties or municipalities currently undertakes land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. Views of the proposed action would be blocked from sensitive viewpoints accessible to the public by mountainous terrain.

Idaho National Engineering Laboratory

Land Use. The proposed ceramic immobilization facility would be located on undeveloped land in the ICPP security area which is situated within the central core area/Prime Development Land Zone of INEL (IN DOE 1992g:12). Construction and operation of the facility would be consistent with the current *Idaho National Engineering Laboratory Site Development Plan* which designates the future land use of the ICPP as receiving and storing spent nuclear fuels and radioactive wastes (IN DOE 1994d:9-8). [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction and operation would not be in conflict with land-use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operation would be compatible with the present visual character of INEL, which consists of large industrial facilities and stack plumes. Potential visual impacts could occur during operation from the additional stack plumes; however, the proposal would be consistent with the existing Class 5 industrial character of the ICPP.

Pantex Plant

Land Use. A new ceramic immobilization facility would be located on undeveloped land in Zone 4. The potential action would be inconsistent with the current *Pantex Site Development Plan* master plan which designates Zone 4 for weapons and weapon components for staging (PX DOE 1995g:16). However, Pantex could revise the site development plan should Pantex be selected for this alternative.

Construction would not affect other Pantex or offsite land uses. There would be no impacts to prime farmland. The alternative would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] Potential visual impacts could occur during operation from the additional stack plumes; however, the visual environment would be consistent with the existing industrialized landscape character, and VRM Class 5 designation of Zone 4.

Oak Ridge Reservation

Land Use. A new ceramic immobilization facility would be located on undeveloped land at the northwest quadrant of the Route 95/Bear Creek Road intersection. The alternative would be in conformance with future land-use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan*, which designates a portion of the site as a major waste management area (OR DOE 1991f:1-7). [Text deleted.]

Construction and operation would be compatible with ORR and offsite land uses. No prime farmlands exist onsite. A new ceramic immobilization facility would not be in conflict with city of Oak Ridge land-use plans, policies, and controls since the current *Oak Ridge Area Land Use Plan* designates the potential site for Industrial and Public land use.

Visual Resources. [Text deleted.] Construction and operation of the facility would change the current VRM Class 4 designation of the Bear Creek Road/Route 95 site to Class 5. Additionally, potential visual impacts could occur during operations from the new stack plumes. Construction and operation activities would be highly visible from Bear Creek Road and Route 95, public roadways with high sensitivity levels.

Savannah River Site

Land Use. A new ceramic immobilization facility would be located on undeveloped land in the F-Area. Facility construction and operation would conform with existing and future land use as designated by the *Savannah River Site Development Plan*. According to the plan, current F-Area land use is designated Industrial Operations, while the future land-use category is primary industrial mission. Specifically, the F-Area is one of four SRS waste management facilities (SR DOE 1994d:2,11,12). [Text deleted.]

Construction and operation would not affect other SRS or offsite land uses. There is no prime farmland on SRS. Construction would not be in conflict with local land use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. [Text deleted.] Construction would occur within an area of similar industrial landscape character. Potential visual impacts could occur during operation from additional stack plumes; however, the proposal would be consistent with the VRM Class 5 designation of the F-Area.

[Text deleted.]

4.3.4.2.2 Site Infrastructure

Implementation of the alternative for ceramic immobilization requires construction and operation of facilities to conduct the ceramic immobilization processes. Data for annual construction and operations are presented in Appendix C. Site infrastructure changes resulting from such construction are presented in Table 4.3.4.2.2-1 and changes from operations in Table 4.3.4.2.2-2 for six representative sites.

Hanford Site

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts to the site infrastructure would be negligible. Hanford would require additional natural gas supplies to operate the ceramic immobilization facility. Since natural gas availability is governed by usage and not by storage capacity onsite, the additional natural gas required for operations could be procured through normal contractual means.

Nevada Test Site

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers. Since NTS uses fuel oil as its primary utility fuel, use of natural gas in lieu of fuel oil would require additional infrastructure during operations. The final facility design could be converted to use fuel oil. Construction and operation of this facility could require construction of transportation links to the existing road and rail networks, of less than 5 km (3 mi). Since NTS does not use natural gas, this facility would be designed to burn fuel oil if NTS were selected as the site.

Idaho National Engineering Laboratory

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts to the site infrastructure would be negligible. Since INEL does not use natural gas, this facility would be designed to burn fuel oil if INEL were selected as the ceramic immobilization facility site.

Pantex Plant

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts to the site infrastructure would be negligible. Additional oil would be required during the period of construction. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required for construction could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers.

Oak Ridge Reservation

[Text deleted.] Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contractual means or the construction companies could provide for this additional oil from local suppliers. Construction and operation of this facility would require construction of transportation

Table 4.3.4.2.2-1. Additional Site Infrastructure Needed for the Construction of the Ceramic Immobilization Alternative (Annual)

Facility Requirement	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	8,000	1.5	2,200,000	0	0
Hanford					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	353,500	59.5	11,534,800	21,039,531	0
Amount required in excess of site availability	0	0	0	0	0
NTS					
Site availability	176,844	45	5,716,000	0	0
Projected usage without facility	124,940	25	5,716,000	0	0
Projected usage with facility	132,940	26.5	7,916,000	0	0
Amount required in excess of site availability	0	0	2,200,000 ^a	0	0
INEL					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage without facility	232,500	42	5,820,000	0	11,340
Projected usage with facility	240,500	43.5	8,020,000	0	11,340
Amount required in excess of site availability	0	0	0	0	0
Pantex					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	46,266	10	795,166	7,200,000	0
Projected usage with facility	54,266	11.5	2,995,166	7,200,000	0
Amount required in excess of site availability	0	0	1,219,446 ^a	0	0
ORR					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	734,000	111.5	2,579,000	95,000,000	16,300
Amount required in excess of site availability	0	0	2,163,000 ^a	0	0
SRS					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	794,000	116	28,390,500	0	221,352
Projected usage with facility	802,000	118	30,590,500	0	221,352
Amount required in excess of site availability	0	0	2,200,000 ^a	0	0

^a Fuel oil requirements in excess of site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Table 4.3.4.2.2–2. Additional Site Infrastructure Needed for the Operation of the Ceramic Immobilization Alternative (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	< 5	< 5	25,000	3	190,000	3,500,000	0
Hanford							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	420	204	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	425	209	370,500	61	9,524,800	24,539,531	0
Amount required in excess of site availability	< 5	< 5	0	0	0	3,500,000 ^a	0
NTS							
Site availability	1,100 ^b	0	176,844	45	5,716,000	0	0
Projected usage without facility	645	0	124,940	25	5,716,000	0	0
Projected usage with facility	650	< 5	149,940	28	5,906,000	3,500,000	0
Amount required in excess of site availability	0	< 5	0	0	190,000 ^c	3,500,000 ^a	0
INEL							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage without facility	445	48	232,500	42	5,820,000	0	11,340
Projected usage with facility	450	53	257,500	45	6,010,000	3,500,000	11,340
Amount required in excess of site availability	< 5	< 5	0	0	0	3,500,000 ^a	0
Pantex							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	76	27	46,266	10	795,166	7,200,000	0
Projected usage with facility	81	32	71,266	13	985,166	10,700,000	0
Amount required in excess of site availability	< 5	< 5	0	0	0	0	0
ORR							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	71	27	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	76	32	751,000	113	569,000	98,500,000	16,300
Amount required in excess of site availability	< 5	< 5	0	0	153,000 ^c	0	0

Table 4.3.4.2.2–2. Additional Site Infrastructure Needed for the Operation of the Ceramic Immobilization Alternative (Annual)—Continued

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
SRS							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	230	103	794,000	116	28,390,500	0	221,352
Projected usage with facility	235	108	819,000	119	28,580,500	3,500,000	221,352
Amount required in excess of site availability	< 5	< 5	0	0	190,000 ^c	3,500,000 ^a	0

^a Facility would be adapted to use fuel oil instead of natural gas.

^b Includes paved and unpaved roads.

^c Fuel oil requirements in excess of site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

links to the existing road and rail networks. DOE plans to site this facility close to existing roads and railroads to ensure that such construction and operations impacts to the site infrastructure would be negligible.

Savannah River Site

[Text deleted.] Construction and operation of this facility would require construction of transportation links to the existing road and rail networks. DOE plans to site this facility close to the existing roads and railroads to ensure that such construction and operations impacts to the site infrastructure would be negligible. Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contracts, or the construction companies could provide for this additional oil from local suppliers. Because SRS does not use natural gas, this facility would be designed to burn fuel oil if SRS were selected as the ceramic immobilization facility site.

4.3.4.2.3 Air Quality and Noise

Construction and operation of the ceramic immobilization facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.4.2.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM₁₀ and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction. Construction impacts would be lower if existing facilities were used.

Emission rates for operation of the ceramic immobilization facility are presented in Table F.1.3–10. Air pollutant emissions sources associated with operations include the following:

- Increased operation of existing boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- [Text deleted.]

The PSD regulations, which are designed to protect ambient air quality in attainment areas, apply to new sources and major modifications to existing sources. Based on the emission rates presented in Appendix F, PSD permits may be required for this alternative at any of the sites. This may require “offsets,” reductions of existing emissions, to permit any additional or new emission source.

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for facility operation, plus the No Action concentrations, are presented in Table 4.3.4.2.3–1. VOCs are the only toxic/hazardous emissions and were not modeled for this PEIS.

NOISE

The location of the facilities associated with the ceramic immobilization facility relative to the site boundary and sensitive receptors was examined for each site to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include

Table 4.3.4.2.3-1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Ceramic Immobilization Alternative and No Action Alternative

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines ^a (µg/m ³)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			Action (µg/m ³)		No Action (µg/m ³)		Total (µg/m ³)		No Action (µg/m ³)		Total (µg/m ³)		Total (µg/m ³)	
			Guidelines ^a (µg/m ³)		Total (µg/m ³)		Action (µg/m ³)		Total (µg/m ³)		Action (µg/m ³)		Total (µg/m ³)	
Criteria Pollutant														
Carbon monoxide	8-hour	10,000	0.08	39.68	2,290	2,321.46	284	383.5	602	984.8	5	14.81	22	360.7
Lead	1-hour	40,000	0.3	314.95	2,748	2,970.3	614	865.9	2,900	4,897	11	31.31	171	1,765
	Calendar Quarter	1.5	<0.01	<0.01	b	b	0.001	0.001	0.09	0.09	0.05	0.05	<0.01	<0.01
	24-hour	0.5	<0.01	<0.01	c	c	c	c	c	c	c	c	c	c
Nitrogen dioxide	Annual	100	0.03	3.75	b	0.56 ^d	4	9.08	2.15	22.95	3	3.84	5.7	21.91
Ozone ^e	1-hour	235	c	e	e	e	e	e	e	e	e	e	e	e
Particulate matter less than or equal to 10 microns in diameter	Annual	50	<0.01	<0.01	9.4	9.4	5	5.01	8.73	8.75	1	1	3	3.02
Sulfur dioxide	24-hour	150	0.02	0.06	106	106	80	80.11	88.5	88.91	2	2.01	50.6	50.97
	Annual	52	<0.01	<0.01	8.4	8.4	6	6	<0.01	<0.01	2	2	14.5	14.5
	24-hour	260	<0.01	<0.01	94.6	94.6	135	135	<0.01	0.05	32	32	196	196.03
	3-hour	1,300	0.01	0.04	725	725	579	579	<0.01	0.21	80	80	823	823.21
	1-hour ^f	1,018	0.02	0.11	c	c	c	c	c	c	c	c	c	c
	1-hour	655 ^f	0.02	0.11	c	c	c	c	c	c	c	c	c	c
	30-minute	1,045	c	c	c	c	c	c	<0.01	0.54	c	c	c	c
Mandated by State														
Gaseous fluoride (as HF)	30-day	0.8	b	b	c	c	c	c	<0.75	<0.75	0.2	0.2	0.09	0.09
	7-day	1.6	b	b	c	c	c	c	<0.75	<0.75	0.3	0.3	0.39	0.39
	24-hour	2.9	b	b	c	c	c	c	0.75	0.75	0.6 ^g	0.6 ^g	1.04	1.04
	12-hour	3.7	b	b	c	c	c	c	1.05	1.05	0.6 ^g	0.6 ^g	1.99	1.99
	8-hour	250	c	c	c	c	c	c	c	c	0.6	0.6	c	c
	3-hour	4.9	c	c	c	c	c	c	4.21	4.21	c	c	c	c

Table 4.3.4.2.3-1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Ceramic Immobilization Alternative and No Action Alternative—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines ^a (µg/m ³)	Hanford		NTS		INEL		Pantex		ORR		SRS	
			No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)
Hydrogen sulfide	1-hour	112	c	c	b	c	c	c	c	c	c	c	c	c
	30-minute	111	c	c	c	c	c	c	b	b	c	c	c	c
Total suspended particulates	Annual	60	<0.01	<0.01	c	c	5	5.01	c	c	c	c	12.6	12.62
	24-hour	150	0.02	0.06	c	c	80	80.11	c	c	2	2.01	c	c
	3-hour	200	c	c	c	c	c	c	b	2.29 ^d	c	c	c	c
	1-hour	400	c	c	c	c	c	c	b	6.15 ^d	c	c	c	c
[Text deleted.]														

^a The more stringent of the Federal and State standards is presented for the averaging time.

[Text deleted.]

^b No sources of this pollutant have been identified.

^c No State standard for indicated averaging time.

^d The concentration represents the alternative contribution only.

^e Ozone, as a criteria pollutant, is not directly emitted or monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

^f At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.

^g 8-hour averaging time concentration was used.

Note: Total concentrations are based on site contribution, including contribution from ongoing activities (No Action), and do not include the contribution from non-facility sources. Concentrations from other hazardous/toxic pollutants reported for No Action in Section 4.2 are unchanged for this alternative and are not shown here.

Source: 40 CFR 50; ID DHW 1995a; ID DHW 1995b; ILLNL 1996d; NV DCNR 1995a; SC DHEC 1991a; SC DHEC 1992b; TN DEC 1994a; TN DHE 1991a; TX ACB 1987a; TX NRCC 1992a; TX NRCC 1995a; WA Ecology 1994a.

heavy-construction equipment and increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Nontraffic noise sources associated with operation of these facilities include ventilation systems, cooling systems, and emergency diesel generators. These noise sources would be located at sufficient distance from offsite areas so that the contribution to offsite noise levels would continue to be small. Due to the size of the sites, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.4.2.4 Water Resources

The construction and operation of a ceramic immobilization facility would affect water resources. Water resource requirements and discharges provided in Tables C.1.1.3–5 and C.2.1.3–5 and Table E.3.3.5–1, were used to assess impacts to surface water and groundwater. The discussion of impacts is provided for each site separately. Table 4.3.4.2.4–1 presents No Action surface water and groundwater uses and discharges at each site, and the potential changes resulting from construction and operation of the ceramic immobilization facility to a HLW repository.

Hanford Site

Surface Water. Surface water from the Columbia River would be used as the water source for construction and operation of the ceramic immobilization facility. During construction, the quantity of water required would be approximately 38 million l/yr (10 million gal/yr), which would represent a 0.3-percent increase over the projected annual surface water withdrawal (13,511 million l/yr [3,569 million gal/yr]). During operation, the total annual water requirement for the ceramic immobilization facility would be approximately 250 million l/yr (66 million gal/yr). This would represent a 1.9-percent increase over the projected surface water annual withdrawal and would increase Hanford's total withdrawals to 0.04-percent of the minimum average flow of the Columbia River. These additional withdrawals would have a negligible impact on surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary wastewater (28.8 million l/yr [7.6 million gal/yr]) would be generated, treated, and discharged to evaporation/percolation ponds. This amount would represent a 11.7-percent increase in the annual amount being discharged. During operation, approximately 98 million l/yr (25.9 million gal/yr) of sanitary and other wastewater would be recycled or discharged to evaporation/percolation ponds. This amount would represent a 39.8-percent increase in the amount being discharged. All discharges would be monitored to comply with discharge requirements.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown, etc.) would be monitored, collected, and treated if necessary prior to recycle within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity and effluents would be automatically diverted to the effluent retention tank if contamination were detected.

The ceramic immobilization facility would be located in the 200 Area which is above the 100-year, 500-year, and probable maximum flood boundaries; flooding from dam failures; and flooding from a landslide resulting in river blockage.

Groundwater. No groundwater would be used for construction or operation of the facility; therefore there would be no impact to groundwater availability. Construction and operation of the facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds which does not evaporate, however, could percolate downward into the near surface aquifer groundwater. This water would be monitored and would not be discharged to the ponds until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of the potential impacts to groundwater quality are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Table 4.3.4.2.4-1. Potential Changes to Water Resources Resulting From the Ceramic Immobilization Alternative

Affected Resource Indicator	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground
Water Source												
No Action water requirements (million l/yr)	13,511	2,400	13,511	2,400	7,570	249	14,760	249	14,760	13,247		
No Action wastewater discharge (million l/yr)	246	82	246	82	540	141	2,277	141	2,277	700		
Construction												
Water Availability and Use												
Total water requirement (million l/yr)	38	38	38	38	38	38	38	38	38	38		
Percent increase in projected water use ^a	0.3	1.6	0.3	1.6	0.5	15.3	0.3	15.3	0.3	0.3		
Water Quality												
Total wastewater discharge (million l/yr)	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8		
Percent change in wastewater discharge ^b	11.7	35.1	11.7	35.1	5.3	20.4	1.3	20.4	1.3	4.1		
Percent change in streamflow	neg	NA	neg	NA	NA	NA	0.06 ^c	NA	0.06 ^c	0.6 ^d		
Operation												
Water Availability and Use												
Total water requirement (million l/yr)	250	250	250	250	250	250	250	250	250	250		
Percent increase in projected water use ^e	1.9	10.4	1.9	10.4	3.3	100	1.7	100	1.7	1.9		
Water Quality												
Total wastewater discharge (million l/yr)	98	98	98	98	98	98	98	98	98	98		
Percent change in wastewater discharge ^f	39.8	119.5	39.8	119.5	18.1	69.5	4.3	69.5	4.3	14.0		
Percent change in streamflow	neg	NA	neg	NA	NA	NA	0.2 ^c	NA	0.2 ^c	1.9 ^d		
Floodplain												
Is action in 100-year floodplain?	No	No	No	No	No	No	No	No	No	No		
Is critical action in 500-year floodplain?	No	Uncertain	No	Uncertain	Uncertain	No	Uncertain	No	Uncertain	Unlikely		

^a Percent increases in water requirements during construction of the ceramic immobilization facility are calculated by dividing water requirements for the facility (38 million l/yr with that for each site No Action water requirements: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (700 million l/yr).

^b Percent changes in wastewater discharged during construction for the new ceramic immobilization facility are calculated by dividing wastewater discharges for the facility (28.8 million l/yr) with the No Action wastewater discharge for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

^c Percent changes in stream flow from wastewater discharges are calculated from the average flow of Clinch River (132 m³/s) and East Fork Poplar Creek (1.5 m³/s). The comparison for the East Fork Poplar Creek is shown in the table.

^d Percent changes in stream flow from wastewater discharges are calculated from the minimum flow of the Fourmile Branch (0.16 m³/s).

^e Percent increases in water requirements during operation of the ceramic immobilization facility are calculated by dividing water requirements (250 million l/yr with that for each site No Action water requirements: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (700 million l/yr).

^f Percent changes in wastewater discharged during operation of the ceramic immobilization facility are calculated by dividing wastewater discharge rate for the new facility (98 million l/yr) with the No Action wastewater discharge for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only through the construction period. Impacts from operations would occur continuously.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Nevada Test Site

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with facility; groundwater would be used as the water source for construction and operation of the ceramic immobilization facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary wastewater, and other nonhazardous wastewater (28.8 million l/yr [7.6 million gal/yr]), would be generated. During operation, a maximum of approximately 98 million l/yr (25.9 million gal/yr) of sanitary and other wastewater would be discharged to a new wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycle.

Water from heating the facility will be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Condensation from heating, air conditioning and other distillates, fire sprinkler water and truck hose-down water would be monitored for radioactivity, and if uncontaminated, available for recycle or discharge to natural drainage channels.

No studies to assess the 500-year floodplain boundaries at NTS have been conducted. Studies of the 100-year floodplain have shown it to be confined to the Jackass Flats and Frenchman Lake areas. The proposed site for the ceramic immobilization facility is not located in either of these areas. However, since the NTS is in a region where most flooding occurs by locally intense thunderstorms which can create brief (less than 6 hours) flash floods, the facilities would be designed to withstand such flooding. Information on the location of the 500-year floodplain could be developed in future environmental studies.

Groundwater. All water required for construction and operation would be supplied from groundwater. Quantities required and the percent increase in projected water use are shown in Table 4.3.4.2.4–1. Construction water requirements for the facilities (38 million l/yr [10 million gal/yr]) would represent approximately 0.1 percent of the minimum estimated annual recharge (38 billion l/yr [10 billion gal/yr]) to the regional aquifer under the entire NTS. As shown in Table 4.3.4.2.4–1, the quantity of water required for construction of the proposed facility would represent a 1.6-percent increase over the projected No Action groundwater use. Operating the facility at NTS would require 250 million l/yr (66 million gal/yr), which is approximately 10.4 percent of the projected groundwater use. This additional withdrawal would represent 0.7 percent of the estimated minimum annual recharge, and would increase the total amount withdrawn annually at NTS to 7.0 percent of the estimated annual recharge. These additional withdrawals would not impact groundwater availability.

Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged to the ponds until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combine effects of a deep water table, low discharge volumes, and high evaporation rates.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the ceramic immobilization facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary wastewater (28.8 million l/yr [7.6 million gal/yr]) would be generated, treated, and discharged to evaporation/percolation ponds, or be available for recycle. During operation, approximately 98 million l/yr (25.9 million gal/yr) of sanitary and other nonhazardous liquids (including industrial wastewater, cooling water, blowdown, and stormwater runoff) would be treated and discharged to evaporation/percolation ponds, or be available for recycle. All discharges would be monitored to comply with discharge limits.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown) would be monitored, collected, and treated, if necessary, prior to recycle within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity and effluents would be automatically diverted to the effluent retention tank if contamination is detected.

The candidate site for the ceramic immobilization facility is not located in an area historically prone to flooding, but is within the flood zone which could occur as a result of the failure of the MacKay Dam during a maximum probable flood. This flood event would be more critical than either the 100- or 500-year flood. Because INEL is in a region where flash floods could occur, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. As shown in Table 4.3.4.2.4-1, construction water requirements for the facility (38 million l/yr [10.0 million gal/yr]), would represent a 0.5-percent increase over the projected annual groundwater usage and would be within INEL's current allotment. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr) has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). No impacts to groundwater availability would occur. During operation, the water requirements for the facilities would be 250 million l/yr (66 million gal/yr). This would represent a 3.3-percent increase over the projected annual groundwater usage; INEL would still be well within the total groundwater allotment.

Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater and would not be expected to contribute to existing near surface contamination. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged to the disposal ponds until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combine effects of a deep water table, low discharge volumes, and high evaporation rates.

Pantex Plant

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for construction and operation of the ceramic immobilization facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the ceramic immobilization facility, sanitary wastewater (28.8 million l/yr [7.6 million gal/yr]) would be generated and discharged to the existing wastewater treatment systems north of Zone 12. During operation, a maximum of approximately 98 million l/yr (25.9 million gal/yr) of sanitary wastewater and other wastewater would be discharged to these wastewater treatment systems. After treatment, all wastewater generated during construction and operation would be discharged to the playa lakes or would be recycled. Since Pantex discharged approximately 1.4 million l/day (0.37 million gal/day) of wastewater into the

playas in 1994 and since this quantity is expected to decrease in the future, the expected quantity of additional wastewater potentially discharged to the playas should not cause any exceedance of the monthly average limit of 2.46 million l/day (0.65 million gal/day).

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, cooling system blowdown) would be monitored, collected, and treated if necessary prior to recycle within the facility or discharge to the playas. These wastes would be sampled continuously for radioactivity and effluents would be automatically diverted to the effluent retention tank if contamination is detected.

The proposed location for the ceramic immobilization facility is in Zone 4. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in Zone 4, there would be no impacts to floodplains. However, flooding in other areas of Pantex could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. All water required for construction and operation would be supplied from groundwater using the existing supply system which obtains water from the Ogallala Aquifer or possibly from reclaimed wastewater. Construction water requirements for the ceramic immobilization facilities would be small relative to the recoverable water in aquifer storage, which for the year 2010 was estimated to be 287 trillion l (75.8 trillion gal) (PX WDB 1993a:1). As shown in Table 4.3.4.2.4-1, construction of the proposed consolidated facilities would require 38 million l/yr (10 million gal/yr) of water, which would represent approximately a 15.3-percent increase over the projected annual No Action groundwater usage and 2-percent of the capacity of the groundwater wells. [Text deleted.] Previous studies have shown that when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala Aquifer, an average of 1.8 m/yr (5.9 ft/yr) decline in the water table occurred over a 10-year period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the ceramic immobilization facilities at Pantex would require 250 million l/yr (66 million gal/yr) resulting in a small drawdown representing 13.2 percent of the capacity of the groundwater system. This additional drawdown would not impact regional groundwater levels. The total site groundwater withdrawal including this facility would be 449 million l/yr (131.8 million gal/yr) which, because of expected cutbacks in other programs, would be 40 percent less than the 836 million l/yr (221 million gal/yr) currently being withdrawn from wells at Pantex.

Construction and operation of the ceramic immobilization facility would not result in direct discharges to groundwater. Treated wastewater discharged to playas, however, could percolate downward into the groundwater of the near surface aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified by the TNRCC. [Text deleted.]

Although the expected drawdowns caused by withdrawing the water required for this alternative are small, the overall decline in groundwater levels in the Amarillo area is of concern. Possible groundwater conservation measures at Pantex that could be considered includes decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Oak Ridge Reservation

Surface Water. Water required for construction and operation of the ceramic immobilization facility would be obtained from the Clinch River and its tributaries. [Text deleted.] During construction, the quantity of water required would be approximately 38 million l/yr (10 million gal/yr), which would represent a 0.3-percent increase over the projected annual No Action surface water withdrawal. During operation, water requirements would be approximately 250 million l/yr (66 million gal/yr). This would represent a 1.7-percent increase over the projected annual No Action surface water withdrawal. Total ORR withdrawals would be 0.4-percent of the

average flow of the Clinch River ($132 \text{ m}^3/\text{s}$ [$4,647 \text{ ft}^3/\text{s}$]). Minimal impacts to surface water availability would occur.

During construction of the ceramic immobilization facility, sanitary wastewater (28.8 million l/yr [7.6 million gal/yr]) would be generated, treated, and discharged to East Fork Poplar Creek. During operation, a total of 98 million l/yr (25.9 million gal/yr) of wastewater would be generated by the facility. This quantity would represent about 0.2-percent of the minimum flow of East Fork Poplar Creek and a 4.3-percent increase in annual discharge amounts. All discharges would be monitored to comply with discharge requirements. No impacts are expected.

All chemical and industrial liquid nonradioactive waste streams (for example, system condensate, fire sprinkler water, etc.) would be monitored, collected, and treated if necessary prior to recycle within the facility or discharged to natural drainage channels. These wastes would be sampled continuously for radioactivity and effluents would be automatically diverted to the effluent retention tank if contamination is detected.

The potential site location of the ceramic immobilization facility is located outside the 100-year floodplain; there would be no impact to the floodplain. The 500-year floodplain has not been determined in this area but could be developed in future studies.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater; therefore, neither groundwater quality nor availability would be affected.

Savannah River Site

Surface Water. No surface water withdrawals would be made; groundwater would be used for all construction and operation needs of a new ceramic immobilization facility. During construction of the ceramic immobilization facility, sanitary and other nonhazardous wastewater (28.8 million l/yr [7.6 million gal/yr]) would be generated and discharged to the sitewide wastewater treatment system, which would not require any modifications. This would represent a 4.1-percent increase in the effluent from this facility. If existing facilities were used, there would be less water used and wastewater discharged during construction. During operation, approximately 98 million l/yr (25.9 million gal/yr) of sanitary wastewater would be discharged to this wastewater treatment system. This would represent a 14.0-percent increase in the effluent discharged to Fourmile Branch from this facility. This discharge would not exceed 1.9 percent of the minimum flow of this stream; no impacts are expected. All discharges would be monitored to comply with discharge requirements. Other nonhazardous wastewater effluents (for example, condensation from air conditioning and heating, fire sprinkler water, cooling system blowdown) would be collected, monitored, and treated if necessary prior to recycle within the facility or discharge to the environment. These wastes would be sampled continuously for radioactivity and effluents would be automatically diverted to the effluent retention tank if contamination is detected.

The potential location for a new ceramic immobilization facility is outside the 100-year floodplain. Although, information on the location of the 500-year floodplain at SRS is currently available only for a limited number of specific project areas, the ceramic immobilization facility at SRS would not likely affect, or be affected by the 500-year floodplain of either the Fourmile Branch or Upper Three Runs Creek. This is because the facility would be located at an elevation of about 91 m (300 ft) above MSL and is approximately 33 m (107 ft) and 64 m (210 ft) above these streams and at distances from these streams of 0.8 km (0.5 mi) to 1.5 km (0.94 mi), respectively. The maximum flow that has occurred on the Upper Three Runs Creek was in 1990, with a flow rate of about $58 \text{ m}^3/\text{s}$ ($2,040 \text{ ft}^3/\text{s}$). At that time the creek reached an elevation of almost 30 m (98 ft) above MSL (SR USGS 1996a:1). The elevations of the buildings in F-Area are more than 63 m (202 ft) above the highest flow elevation of the Upper Three Runs Creek. The maximum flow that has occurred on the Fourmile Branch was in 1991 with a rate of approximately $5 \text{ m}^3/\text{s}$ ($186 \text{ ft}^3/\text{s}$), and an elevation of about 61 m (199 ft) above MSL.

(SR USGS 1996a:1). Elevations of the buildings in F-Area would be more than approximately 31 m (101 ft) higher than the maximum flow level that has occurred.

Groundwater. During construction, the quantity of water required would be approximately 38 million l/yr (10 million gal/yr), which would represent a 0.3-percent increase over the projected annual No Action groundwater withdrawal. This additional withdrawal should cause negligible impacts to groundwater availability. During operation, water used for cooling system makeup would be obtained from existing supply systems in the F-Area. The water for these systems is groundwater from the Cretaceous Aquifer. Water requirements during operations (250 million l/yr [66 million gal/yr]), as shown in Table 4.3.4.2.4-1, represent a 1.9-percent increase in the projected No Action groundwater usage at SRS. There would be reduced impacts if existing facilities are used. These additional withdrawals would not impact regional groundwater levels. Previous studies using numerical simulations of groundwater withdrawals from the Cretaceous Aquifer of eight times greater than that required for the ceramic immobilization facility indicate that drawdown could be almost 2.1 m/yr (6.9 ft/yr) at the well head, but would be smaller in overlying aquifers and would not extend beyond SRS boundaries in any aquifer (DOE 1991c:5-196). Therefore, it is expected that the withdrawals attributed to the ceramic immobilization facility would cause a small drawdown at the well head and should not affect any aquifers in the area.

No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected.

[Text deleted.]

4.3.4.2.5 *Geology and Soils*

This section describes the environmental impacts to the geologic and soil resource as related to the construction and operation of the ceramic immobilization facility. This facility at any of the alternative sites, would involve some ground-disturbing construction activities (20 ha [49 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. The relative amount of annual precipitation (rain) is greater at ORR and SRS than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on the geologic resource are anticipated. Neither facility construction and operational activities or site infrastructure improvements would restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is low for Pantex, Hanford, INEL, and NTS. The soil erosion potential for ORR and SRS during construction and operational activities is moderate due primarily to greater relative annual precipitation. Soil disturbance would occur primarily from ground-breaking construction activities (foundation preparation) and associated with building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (increase wind velocities and durations increase potential soil erosion), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns. Soil loss associated with construction would be less if existing facilities were used for part of the immobilization process.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvement (buildings, roads, and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal.

[Text deleted.]

4.3.4.2.6 *Biological Resources*

Construction of the ceramic immobilization facility would require 20 ha (49 acres) of land at each of the DOE sites analyzed. This includes areas on which plant facilities would be constructed, as well as areas used for construction laydown. Land requirements and impacts on biological resources would be less if existing facilities were used for portions of the ceramic immobilization operations. Consultation with USFWS and State agencies would be conducted at the site-specific level as appropriate to avoid potential impacts to threatened and endangered species, and other protected species and habitat.

Hanford Site

It is assumed that a new ceramic immobilization facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility would result in the disturbance of terrestrial habitat equaling about 0.01 percent of Hanford. This includes areas on which plant facilities would be constructed as well as areas that would be revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. The assumed facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the ceramic immobilization facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the ceramic immobilization facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the ceramic immobilization facility would not affect wetlands since no wetlands exist near the assumed facility location. Groundwater would be used and wastewater would be discharged to evaporation/infiltration ponds; therefore, wetlands would not be affected.

Aquatic Resources. Construction of a ceramic immobilization facility at Hanford would not impact aquatic resources since there are no surface water bodies sufficiently near the assumed facility location so as to be directly affected by construction activities or indirectly affected by runoff. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure. Since the volume of water included represents a small percentage of the flow of the river, impacts to aquatic resources would be minimal. Wastewater would be discharged to evaporation/infiltration ponds; therefore, aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the ceramic immobilization facility; however, sagebrush habitat would be disturbed. The sagebrush community is important nesting/breeding and foraging habitat for several State-listed and candidate species such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the ceramic immobilization facility would be located in the Frenchman Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility at NTS would result in the disturbance of terrestrial habitat equaling about 0.01 percent of NTS. Vegetative cover within the assumed facility location, which is primarily creosote bush (Figure 3.3.6–1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the ceramic immobilization facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operations, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the ceramic immobilization facility would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the ceramic immobilization facility would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location.

Threatened and Endangered Species. The threatened desert tortoise is a federally listed species that could be affected by construction of the ceramic immobilization facility at NTS. Construction activities such as land clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicle traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training, putting restrictions on vehicle speeds and off-road movement, conducting clearance surveys prior to surface disturbance, approving stop work authority if tortoises are found within work areas, removing tortoises from roadways and work areas, placing permanent and temporary tortoise-proof fencing around trenches, landfills, and treatment ponds, inspecting trenches, and having biologists survey when heavy equipment is in

use. The USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the ceramic immobilization facility.

[Text deleted.] Any listed plant species (Table 3.3.6–1) located within the construction area would be lost during land-clearing activities. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicle traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on the NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the ceramic immobilization facility (Section 4.3.4.2.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that the ceramic immobilization facility would be constructed within an undeveloped portion of the ICPP area. The ICPP area falls within the big sagebrush/thickspike wheatgrass/needle-and-thread grass community. Impacts to wildlife would be limited to smaller mammals and some birds and reptiles which could be displaced or suffer mortality. Larger mammals are excluded from the assumed facility location by the perimeter fence and thus would not be impacted. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the area would have already adapted to similar disturbances. Due to the lack of wetlands or aquatic resources near the assumed facility location, these resources would not be affected by construction or operation of the ceramic immobilization facility. Since the facility would be located within the ICPP security area, impacts to threatened and endangered species would not be expected since they are not present at the ICPP.

Pantex Plant

It is assumed that the ceramic immobilization facility would be located within Zone 4 which is a developed area with minimal natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the facility location; however, small mammals and some birds and reptiles could be displaced by construction. Since the area does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional wastewater could lead to an increase in open water near the outfall, as well as a change in plant species composition. No federally listed threatened or endangered species would be affected by construction or operation of the facility. Although the facility location has been disturbed, it is possible that the State-listed Texas horned lizard could be present. Preactivity surveys would be conducted as appropriate prior to construction.

Oak Ridge Reservation

It is assumed that the ceramic immobilization facility would be located about 3 km (2 mi) east of the K-25 area of ORR. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the ceramic immobilization facility at ORR would result in the disturbance of terrestrial habitat equaling about 0.1 percent of ORR. Vegetation within the area to be developed would be destroyed during land clearing. Vegetation cover within the assumed site is predominantly oak-hickory forest or pine and pine-hardwood forest (Figure 3.6.6–1). While both types would be affected by construction, it is likely that a greater area of pine and pine-hardwood forests would be removed. This type of

forest is more heavily concentrated in valleys where most of the development would occur. Oak-hickory forests are typically found on ridges. Both forest types are common throughout ORR and within the region.

Construction of the proposed facility would affect animal populations. Less mobile animals within the assumed project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the proposed facility. These disturbances may cause some species to move from the area. Disturbances to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Because the majority of the area in which the proposed facility would be located is upland, it is expected that direct impacts to wetlands could be avoided. Implementation of erosion and sediment control measures would control secondary impacts. Since an existing intake structure would be used during both construction and operation, it would not be necessary to disturb wetlands along the Clinch River. However, a new wastewater discharge structure could be required on East Fork Poplar Creek. Depending on its location, this structure could displace some wetlands along the creek. Any unavoidable impacts to wetlands would be mitigated.

During construction and operation, discharges would be directed to East Fork Poplar Creek. Discharges would have a minimal impact on the flow of the stream and are not expected to affect associated wetlands. All wastewater discharges would be treated as necessary to meet NPDES permit requirements.

Aquatic Resources. Construction and operation of the ceramic immobilization facility could cause water quality changes (primarily sediment loading and resulting turbidity) to Bear Creek, Grassy Creek, or Ish Creek as a result of soil erosion. Soil erosion and sediment control measures would be implemented to control erosion. Water requirements during both construction and operation would be met by existing site sources. Since a new intake structure would not be required, direct disturbance to aquatic resources in the Clinch River would not occur. Water withdrawal during construction and operation would represent a very small percentage of the Clinch River's average flow and would have little effect on the flow of the river. Increases in impingement and entrainment impacts would, therefore, be minimal and would be unlikely to affect fish populations in the river.

During construction and operation, wastewater would be discharged to East Fork Poplar Creek. This could require the construction of a new discharge structure which would temporarily disturb aquatic habitat in the vicinity of the outfall. The small volume of wastewater discharged to the stream would not be expected to impact aquatic resources during either construction or operation. In addition, NPDES discharge requirements would be met.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species are expected to be affected by construction of the ceramic immobilization facility. Land-clearing activities may destroy State protected plant species found within or adjacent to disturbed portions of the assumed site including pink lady's-slippers, fen orchid, tubercled rein-orchid, American ginseng, purple fringeless orchid, Canada lily,

and golden seal. The Tennessee dace is sensitive to siltation and actively seeks clean gravel for spawning. An increase in amount or duration of sediment runoff to Ish Creek or Bear Creek during facility construction could impact this fish species. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of special status species in the area to be disturbed. No additional impacts are expected during operation of the facility.

[Text deleted.]

Savannah River Site

It is assumed that a new ceramic immobilization facility would be constructed within the F-Area, which is one of the highly developed industrial areas of SRS. Impacts to terrestrial resources would be minimal. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area would have already adapted to similar disturbances. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since water would be taken from existing sources and discharged via NPDES-permitted outfalls and would involve minor volumes. Construction and operation of the ceramic immobilization facility is not expected to impact threatened and endangered species due to the developed nature of the assumed facility location. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the site so that this species would not be directly affected by this action.

4.3.4.2.7 Cultural and Paleontological Resources

This section discusses potential impacts to cultural and paleontological resources that may result from construction and operation of the ceramic immobilization facility at each of the representative sites analyzed. The land to be disturbed during construction totals 20 ha (49 acres) of which 12 ha (30 acres) would be used during operation. If existing facilities were used for a portion of the ceramic immobilization operation, less land would be disturbed and there would be fewer impacts to cultural and paleontological resources. [Text deleted.] For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources were identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. Any such sites may be identified through pre-construction surveys. Any identified sites would be avoided. Operation would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified close to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The ceramic immobilization facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. However, additional unsurveyed lands necessary for the proposed facility may contain prehistoric or historic resources. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Impacts to any prehistoric or historic resources would occur during construction, but not operation, of the proposed facility.

The CGTO has conducted surveys over portions of Frenchman Flat and has identified at least 20 plant species of importance to Native Americans. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from facility construction and operation. Potential impacts include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological remains may be affected by construction, but not operation, of the facility.

Idaho National Engineering Laboratory

The ceramic immobilization facility would be constructed within the existing developed and disturbed ICPP security area. The facility would be sited in a location previously approved for the construction of the Special Isotope Separation Project. A surface survey of the area identified no sites within the proposed project area. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archaeological remains be discovered during construction. Two historic sites occur adjacent to the ICPP—one historic can scatter across the Big Lost River, to the northeast, and one abandoned homestead to the east. The can scatter is not considered eligible for NRHP listing and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed action. Facility construction and operation may have a visual or auditory impact on traditional use areas or sacred sites. Such resources may be identified through consultation with the interested tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain which have produced fossilized remains.

Pantex Plant

The ceramic immobilization facility would be constructed in Zone 4 of Pantex. A historic buildings survey was conducted in Zone 4 to identify significant World War II Era structures and none of the buildings there is considered NRHP-eligible on that basis. Zone 4 has not been systematically surveyed for archaeological sites. Because the area is developed and disturbed, it is unlikely to contain NRHP-eligible archaeological resources. The area is a developed industrial zone and the probability of archaeological sites there is low. In compliance with the standing programmatic agreement, survey work would be conducted on all areas that would be affected by construction prior to ground-breaking activities. Recorded site types at Pantex include lithic scatters, hunting/kill sites, and concentrations of fire-cracked rock, and are located predominantly near the playas. Historic sites are generally associated with farming, such as remains of homes and outbuildings, and World War II and Cold War Era structures. Resources such as these may occur on the land that would be disturbed during construction. Operation would not have an additional impact on archaeological sites.

The Department has initiated a public outreach program to involve Native American groups in decision-making related to land use and cultural resources. To date, none of the Native American tribes known to have traditional interest in Pantex lands have identified any sacred sites, ceremonial areas, or cemeteries in Zone 4. Additional consultation may identify some of these resources. Resources such as cemeteries could be affected by new construction. Operation could have an auditory or visual impact on sacred or ceremonial sites.

Important paleontological remains, such as bison and camel bones, have been found in other areas of the High Plains and it is possible that some may occur in lands to be disturbed by construction at Pantex. Operation would not affect paleontological remains.

Oak Ridge Reservation

This facility would be constructed at the intersection of Route 95 and Bear Creek Road, north of Bear Creek Road. A portion of this area on both sides of Bear Creek Road was surveyed prior to construction of the proposed Exxon Nuclear Facility which was never built (OR UTN 1975a:ii). Some prehistoric sites were identified near the Clinch River, and the potential for sites along the smaller creeks exists. In addition, remains of a number of early 20th-century frame houses and mid-to-late 19th-century log houses and outbuildings are located within the project area. Some of these resources may be affected by facility construction. Prehistoric site types that are known to occur at ORR include remains of prehistoric villages, burial grounds, quarries and lithic workshops,

and shell scatters. Historic resources may include standing structures, as well as remains of dwellings, road traces, cemeteries, and trash scatters. Resources such as these may occur in the area and may be affected by construction, but not operation, of the facility.

No Native American resources have been identified in the project area to date. Some may be identified during project-specific consultation. Native American resources such as ancestral sites, cemeteries, and traditionally used plant and animal species could be affected by construction. Operation may have an auditory or visual impact on sacred or ceremonial sites.

Some paleontological resources may occur in the area to be disturbed during construction but no fossil remains with high research value are known to occur at ORR. During operation, no additional ground disturbance is expected so, there would be no impact to paleontological resources.

Savannah River Site

A new ceramic immobilization facility would be located in open space within F-Area. Portions of F-Area have been surveyed and contain sites that are considered potentially eligible for the NRHP. Additional surveys would be conducted in areas to be disturbed by construction. Site types known to occur at SRS include remains of prehistoric base camps, quarries, and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by facility construction but not operation.

Some Native American resources may be affected by the proposed action. Resources such as prehistoric sites, cemeteries, and traditional plants could be affected by construction. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to these areas may also result from facility construction or operation. These resources would be identified through consultation with the potentially affected tribes.

No scientifically valuable fossilized remains have been recorded at SRS to date. Facility construction and operation are not expected to affect paleontological resources.

[Text deleted.]

4.3.4.2.8 Socioeconomics

This section analyzes the socioeconomic effects of the ceramic immobilization facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. The effects at all of the candidate sites are found in the Supplemental Data Report (Socio 1996a). Socioeconomic impacts attributable to construction would be reduced if existing facilities are used for part of the ceramic immobilization operation.

Regional Economy Characteristics. Constructing the ceramic immobilization facility at any of the sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 1,000 workers in the peak year of construction at any site. The largest increases in regional employment (about 1 percent) and regional per capita income (much less than 1 percent) would be at INEL. A total of 2,030 new jobs (1,000 direct and 1,030 indirect) would be generated and regional unemployment would fall from 5.4 percent to 4.5 percent in the INEL REA (Socio 1996a).

Operating the facility would generate greater socioeconomic changes than would construction, due to the larger, more permanent workforce. A workforce of 860 would be required for full operation at any site. Implementing the alternative at INEL would generate the largest increases in regional employment (about 2 percent) and per capita income (less than 1 percent). A total 3,167 new jobs (860 direct and 2,307 indirect) would be created by the operational activities, and regional unemployment would fall to 3.9 percent (Socio 1996a).

Population and Housing. At all of the sites analyzed, except INEL and Pantex, construction employment requirements would be met by the available resident labor force. However, some in-migrating workers would be needed to fill more specialized positions during operation. Project-related population increases would be the largest at INEL during construction of the facility. Pantex would require the largest number of in-migrating workers for operations; however, population increases in either ROI would be less than 1 percent over No Action projects.

Housing units, in excess of existing vacancies, would be required in the Pantex and INEL ROIs during construction of the project. Additional housing construction would also be required during operation at all sites analyzed, except NTS, to accommodate the in-migrating population. The greatest increase in housing requirement during both phases would be in the INEL ROI, but this would be less than 1 percent over No Action estimates. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the in-migrating population at all of the sites analyzed (Socio 1996a).

Community Services. Constructing the ceramic immobilization facility would increase demand for community services at Pantex and INEL, but not at the other sites analyzed. However, operation of the facility would slightly increase the demand for community services at all of the sites analyzed. The effects of population growth due to in-migrating workers during construction or operations on community services at any of the sites analyzed would be minor. The following discussion focuses on the INEL and Pantex ROIs where the greatest increases in demand for community services would occur.

To maintain the No Action student-to-teacher ratio of 18.5:1 in the INEL ROI, 17 new teachers would be needed during construction. The Pantex ROI would need 22 teachers to maintain the No Action student-to-teacher ratio of 16.3:1 during operation. These increases in teacher requirements, however, would be distributed over several school districts in the ROI, and no single school district would be significantly affected (Socio 1996a).

During construction, 2 police officers and 3 firefighters would be needed to maintain the No Action service levels of 1.6 police officers and 2.2 firefighters per 1,000 persons in the INEL ROI. Three additional police officers and 5 new firefighters would be needed to maintain No Action service levels of 2.3 police officers and 2.3 firefighters per 1,000 persons in the Pantex ROI during operations (Socio 1996a).

Projected hospital occupancy rates would increase slightly over No Action levels at all of the sites analyzed during operations. However projected capacities would be capable of accommodating these small increases in patient load. Two additional physicians would be needed in the INEL ROI during construction and 3 additional physicians during operation in the Pantex ROI to maintain the No Action service levels of 1.2 and 2.0 physicians per 1,000 persons, respectively (Socio 1996a).

Local Transportation. Construction of the ceramic immobilization facility would have the greatest relative effect on local transportation at INEL. A total of 1,920 vehicle trips per day would be generated during the construction of the ceramic immobilization facility. This increase would cause a drop in the level of service to two road segments in the INEL ROI. U.S. 20 from U.S. 26/91 at Idaho Falls to U.S. 26 East would change from D to E; U.S. 20/26 from U.S. 26 East to State Route 22/33 would change from B to C.

Operations at INEL would generate 1,651 vehicle trips per day. The impacts would be the same as described for the construction phase of the ceramic immobilization facility.

4.3.4.2.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the ceramic immobilization facility. The section first describes the impacts from normal facility operation at each potential site followed by a description of impacts from facility accidents. The impacts associated with the ultimate disposal of the immobilized form in an HLW repository are presented separately in technical documents that specifically address repository operations.

Summaries of the radiological impacts to the public and to workers associated with normal operation during the assumed 10-year campaign time are presented in Tables 4.3.4.2.9-1 and 4.3.4.2.9-2, respectively. Impacts from hazardous chemicals to these same groups are given in Table 4.3.4.2.9-3. Summaries of impacts associated with postulated accidents are given in Tables 4.3.4.2.9-4 through 4.3.4.2.9-9. Detailed results are presented in Section M. For the Preferred Alternative, the duration would be reduced to 3.5 years and the risk and fatalities would also be reduced proportionally. The ceramic immobilization facility would be collocated with the Pu conversion facility under the Preferred Alternative but are analyzed separately in this PEIS.

The DOE's Preferred Alternative for Pu disposition includes the use of vitrification or immobilization technologies for the disposition of Pu in existing reactors. As a result of implementing a multiple technology disposition strategy for analysis purposes, approximately 30 percent of the surplus Pu would be vitrified or immobilized. Summaries of the radiological and hazardous chemical impacts to the public and to workers associated with normal operations and with postulated accidents are presented for an assumed 10-year operational campaign for the disposition of 50 t (55.1 tons) of Pu and for an assumed 3.5-year operational campaign for the Preferred Alternative. The impacts and risks associated with the Preferred Alternative would be reduced due to a shorter period of operations. It should also be noted that a Pu conversion facility may be collocated with the vitrification or immobilization facility. Impacts attributed to the Pu conversion facility are described in Section 4.3.2.9 for 10 years of operation.

Normal Operation. There would be no radiological releases associated with the construction of a ceramic immobilization facility at any of the sites analyzed. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. If existing facilities are used, the hazardous chemical releases would be reduced. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed member of the public resulting from the normal operation of a ceramic immobilization facility at each of the sites are presented in Table 4.3.4.2.9-1. The impacts from all site operations, including the ceramic immobilization facility, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The doses to the maximally exposed member of the public from annual ceramic immobilization facility operation would range from 1.2×10^{-7} mrem at NTS to 4.2×10^{-6} mrem at the ORR site. From 10 years of operation, the corresponding risks of fatal cancer to this individual would range from 6.0×10^{-13} to 2.1×10^{-11} . The impacts to the average individual would be less. As a result of annual facility operations, the population doses would range from 1.7×10^{-7} person-rem at the NTS site to 6.7×10^{-5} person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 8.5×10^{-10} to 3.4×10^{-7} .

Table 4.3.4.2.9-1. Potential Radiological Impacts to the Public During Normal Operation of the
Ceramic Immobilization Alternative

Receptor	Hanford			NTS			INEL			Pantex			ORR			SRS		
	Facility	Site ^a	Total	Facility	Site ^a	Total	Facility	Site ^a	Total	Facility	Site ^a	Total	Facility	Site ^a	Total	Facility	Site ^a	Total
Annual Dose to the Maximally Exposed Individual Member of the Public^b																		
Atmospheric release pathway (mrem)	2.3x10 ⁻⁷	4.4x10 ⁻³	1.2x10 ⁻⁷	4.2x10 ⁻³	1.5x10 ⁻⁷	0.018	1.8x10 ⁻⁶	6.2x10 ⁻⁵	4.2x10 ⁻⁶	1.5	1.3x10 ⁻⁶	0.42						
Drinking water pathway	0	0	0	0	0	0	0	0	0	0	0	0.081						
Total liquid release pathway (mrem)	0	9.5x10 ⁻⁴	0	0	0	0	0	0	0	0	0	0.37						
Atmospheric and liquid release pathways combined (mrem)	2.3x10 ⁻⁷	5.3x10 ⁻³	1.2x10 ⁻⁷	4.2x10 ⁻³	1.5x10 ⁻⁷	0.018	1.8x10 ⁻⁶	6.2x10 ⁻⁵	4.2x10 ⁻⁶	3.2	1.3x10 ⁻⁶	0.79						
Percent of natural background ^c	7.7x10 ⁻⁸	1.8x10 ⁻³	3.8x10 ⁻⁸	1.3x10 ⁻³	4.4x10 ⁻⁸	5.2x10 ⁻³	5.4x10 ⁻⁷	1.9x10 ⁻⁵	1.4x10 ⁻⁶	1.1	4.4x10 ⁻⁷	0.27						
10-year fatal cancer risk	1.2x10 ⁻¹²	2.7x10 ⁻⁸	6.0x10 ⁻¹³	2.1x10 ⁻⁸	7.5x10 ⁻¹³	8.9x10 ⁻⁸	9.0x10 ⁻¹²	3.1x10 ⁻¹⁰	2.1x10 ⁻¹¹	1.6x10 ⁻⁵	6.5x10 ⁻¹²	4.0x10 ⁻⁶						
3.5-year fatal cancer risk ^d	4.2x10 ⁻¹³	9.5x10 ⁻⁹	2.1x10 ⁻¹³	7.4x10 ⁻⁹	2.6x10 ⁻¹³	3.1x10 ⁻⁸	3.2x10 ⁻¹²	1.1x10 ⁻¹⁰	7.4x10 ⁻¹²	5.6x10 ⁻⁶	2.3x10 ⁻¹²	1.4x10 ⁻⁶						
Annual Population Dose Within 80 Kilometers^e																		
Atmospheric release pathway (person-rem)	3.9x10 ⁻⁵	0.46	1.7x10 ⁻⁷	3.7x10 ⁻³	1.4x10 ⁻⁵	2.4	1.9x10 ⁻⁵	3.0x10 ⁻⁴	3.2x10 ⁻⁵	29	6.7x10 ⁻⁵	40						
Total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	4.7	0	3.6						
Atmospheric and liquid release pathways combined (person-rem)	3.9x10 ⁻⁵	1.6	1.7x10 ⁻⁷	3.7x10 ⁻³	1.4x10 ⁻⁵	2.4	1.9x10 ⁻⁵	3.0x10 ⁻⁴	3.2x10 ⁻⁵	34	6.7x10 ⁻⁵	44						
Percent of natural background ^c	2.1x10 ⁻⁸	8.4x10 ⁻⁴	1.8x10 ⁻⁹	4.0x10 ⁻⁵	1.5x10 ⁻⁸	2.7x10 ⁻³	1.6x10 ⁻⁸	2.6x10 ⁻⁷	8.4x10 ⁻⁹	9.0x10 ⁻³	2.5x10 ⁻⁸	0.017						
10-year fatal cancers	2.0x10 ⁻⁷	7.8x10 ⁻³	8.5x10 ⁻¹⁰	1.9x10 ⁻⁵	7.0x10 ⁻⁸	0.012	9.5x10 ⁻⁸	1.5x10 ⁻⁶	1.6x10 ⁻⁷	0.17	3.4x10 ⁻⁷	0.22						
3.5-year fatal cancers ^d	7.0x10 ⁻⁸	2.7x10 ⁻³	3.0x10 ⁻¹⁰	6.7x10 ⁻⁶	2.5x10 ⁻⁸	4.2x10 ⁻³	3.3x10 ⁻⁸	5.3x10 ⁻⁷	5.6x10 ⁻⁸	0.060	1.2x10 ⁻⁷	0.077						

Table 4.3.4.2.9-1. Potential Radiological Impacts to the Public During Normal Operation of the Ceramic Immobilization Alternative—Continued

Receptor	Hanford			NTS			INEL			Pantex			ORR			SRS		
	Facility	Site ^a	Total	Facility	Site ^a	Total	Facility	Site ^a	Total	Facility	Site ^a	Total	Facility	Site ^a	Total	Facility	Site ^a	Total
Annual Dose to the Average Individual Within 80 Kilometers^f																		
Atmospheric and liquid release pathways combined (mrem)	6.3x10 ⁻⁸	2.6x10 ⁻³	5.8x10 ⁻⁹	1.3x10 ⁻⁹	1.3x10 ⁻⁴	5.2x10 ⁻⁸	8.9x10 ⁻³	5.4x10 ⁻⁸	8.6x10 ⁻⁷	2.5x10 ⁻⁸	0.026	7.5x10 ⁻⁸	0.049					
10-year fatal cancer risk	3.1x10 ⁻¹³	1.3x10 ⁻⁸	2.9x10 ⁻¹⁴	6.3x10 ⁻¹⁴	2.6x10 ⁻¹⁰	4.5x10 ⁻¹³	2.7x10 ⁻¹³	4.3x10 ⁻¹²	1.3x10 ⁻¹²	1.3x10 ⁻¹³	1.3x10 ⁻⁷	3.8x10 ⁻¹³	2.5x10 ⁻⁷					
3.5 year fatal cancer risk ^d	1.1x10 ⁻¹³	4.6x10 ⁻⁹	1.0x10 ⁻¹⁴	2.2x10 ⁻¹⁴	9.1x10 ⁻¹⁰	1.6x10 ⁻¹⁴	9.5x10 ⁻¹⁴	1.5x10 ⁻¹²	4.2x10 ⁻¹²	4.6x10 ⁻¹⁴	4.6x10 ⁻⁸	1.3x10 ⁻¹⁴	8.8x10 ⁻⁸					

^a Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9). The location of the MEI may be different under No Action than for operation of ceramic facility. Therefore, the impacts may not be directly additive.

^b The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem, the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem, the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem, the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem, the population within 80 km (50 mi) receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem, the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem, the population within 80 km receives 266,000 person-rem.

^c The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem, the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem, the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem, the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem, the population within 80 km (50 mi) receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem, the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem, the population within 80 km receives 266,000 person-rem.

^d Since the Preferred Alternative would result in the disposition of approximately 30 percent of Pu using vitrification or immobilization technologies, the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced.

^e For DOE activity proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

^f Obtained by dividing the population dose by the number of people projected to be living within 80 km of site in 2030 (621,000 at Hanford, 29,400 at NTS, 269,000 at INEL, 350,000 at Pantex, 1,285,000 at ORR, and 893,000 at SRS).

Source: Section M.2.

The doses to the maximally exposed member of the public from annual total site operations are all within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would range from 6.2×10^{-5} mrem at Pantex to 3.2 mrem at ORR. From 10 years of operation, the corresponding risks of fatal cancers to this individual would range from 3.1×10^{-10} to 1.6×10^{-5} . The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operations, the population doses would be within the limit in proposed 10 CFR 834 and would range from 3.0×10^{-4} person-rem at Pantex to 44 person-rem at SRS. The corresponding numbers of fatal cancers in these populations from 10 years of operation would range from 1.5×10^{-6} to 0.22. The disposition of approximately 30 percent of Pu using vitrification or immobilization technologies would decrease the operational campaign length. As a result, the impacts projected for 50 t (55.1 tons) for the assumed 10-year campaign would be proportionately reduced.

Doses to onsite workers from normal operations are given in Table 4.3.4.2.9–2. Included are involved workers directly associated with the ceramic immobilization facility, workers who are not involved with the immobilization facility, and the entire workforce at each site. All doses fall within regulatory limits.

The annual dose to ceramic immobilization facility workers is site-independent and would be 279 mrem to the average facility worker and 120 person-rem to the entire facility workforce. The annual dose to the average noninvolved worker would range from 2.6 mrem at ORR to 32 mrem at SRS. The annual total dose to all noninvolved workers would range from 3.0 person-rem at NTS to 250 person-rem at Hanford. The annual dose to the total site workforces would range from 123 person-rem at NTS to 370 person-rem at Hanford. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.4.2.9–2.

Table 4.3.4.2.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Ceramic Immobilization Alternative

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce^a						
Average worker dose (mrem/yr) ^b	279	279	279	279	279	279
10-year risk of fatal cancer	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}
3.5-year risk of fatal cancer ^c	3.9×10^{-4}	3.9×10^{-4}	3.9×10^{-4}	3.9×10^{-4}	3.9×10^{-4}	3.9×10^{-4}
Total dose (person-rem/yr)	120	120	120	120	120	120
10-year fatal cancers	0.46	0.46	0.46	0.46	0.46	0.46
3.5-year fatal cancers ^c	0.16	0.16	0.16	0.16	0.16	0.16
Noninvolved Workforce^d						
Average worker dose (mrem/yr) ^b	27	5.0	30	10	2.6	32
10-year risk of fatal cancer	1.1×10^{-4}	2.0×10^{-5}	1.2×10^{-4}	4.0×10^{-5}	1.0×10^{-5}	1.3×10^{-4}
3.5-year risk of fatal cancer ^c	3.9×10^{-5}	7.0×10^{-6}	4.2×10^{-5}	1.4×10^{-5}	3.5×10^{-6}	4.6×10^{-5}
Total dose (person-rem/yr)	250	3.0	220	14	44	226
10-year fatal cancers	1.0	0.012	0.88	0.056	0.18	0.90
3.5-year fatal cancers ^c	0.35	4.2×10^{-3}	0.31	0.020	0.063	0.32

Table 4.3.4.2.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Ceramic Immobilization Alternative—Continued

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Total Site Workforce^e						
Dose (person-rem/yr)	370	123	340	134	164	346
10-year fatal cancers	1.5	0.50	1.4	0.54	0.66	1.4
3.5-year fatal cancers ^c	0.53	0.18	0.49	0.19	0.23	0.49

^a The involved worker is associated with operations of the ceramic immobilization facility.

^b The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

^c Since the Preferred Alternative would result in the disposition of approximately 30 percent of Pu using vitrification or immobilization technologies, the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 10-year campaign would be proportionately reduced to 3.5-year campaign.

^d The noninvolved worker is onsite but not associated with operations of the ceramic immobilization facility. The noninvolved workforce is equivalent to the No Action workforce.

^e The impact to the total workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public resulting from normal operation of the ceramic immobilization facility at each of several sites are presented in Table 4.3.4.2.9–3. Included is the impact due only to operation of the ceramic immobilization facility and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI ranges from 3.9×10^{-4} at NTS to 1.5×10^{-2} at ORR due to the new facility operation. The incremental cancer risk from hazardous chemicals to the MEI is zero (because no carcinogens are released from hazardous chemicals) at all sites. The HI to the onsite worker ranges from 8.1×10^{-2} at Pantex to 0.17 at ORR, and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals) at all sites.

Table 4.3.4.2.9-3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Ceramic Immobilization Alternative

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b
Maximally Exposed Individual (Public)												
Hazard index ^c	2.6x10 ⁻³	2.7x10 ⁻³	3.9x10 ⁻⁴	3.9x10 ⁻⁴	5.6x10 ⁻³	0.021	0.015	0.020	0.015	0.055	7.1x10 ⁻⁴	5.9x10 ⁻³
Cancer Risk ^d	0	0	0	0	0	3.6x10 ⁻⁶	0	1.1x10 ⁻⁸	0	0	0	1.3x10 ⁻⁷
Worker onsite												
Hazard index ^e	0.16	0.16	0.083	0.083	0.16	0.39	0.081	0.087	0.17	0.32	0.14	1.3
Cancer Risk ^f	0	0	0	0	0	7.7x10 ⁻⁴	0	4.5x10 ⁻⁷	0	0	0	1.9x10 ⁻⁴

^a Facility=Contribution from the proposed new facility operation only.

^b Total=Includes the contributions from the No Action and the proposed new facility operation.

^c Hazard Index for MEI=sum of individual Hazard Quotients (noncancer health effects) for MEI.

^d Cancer Risk for MEI=(emissions concentration) x (0.286 [converts concentrations to doses]) x Slope Factor. Where there are no known carcinogens among chemicals emitted, therefore, the calculated cancer risk is 0.

^e Hazard Index for workers=Sum of individual Hazard Quotients (noncancer health effects) for workers.

^f Cancer risk for workers=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [Fraction of year exposed]) x (0.571 [Fraction of lifetime working]) x (Slope Factor). Where there are no known carcinogens among chemicals emitted, there are no Slope Factors; therefore, the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4-54 through M.3.4-59.

Facility Accidents. A set of potential accidents has been postulated for the ceramic immobilization facility for which there may be releases of Pu that may impact onsite workers and the offsite population. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Tables 4.3.4.2.9–4 through 4.3.4.2.9–9 from the sites analyzed (Hanford, NTS, INEL, Pantex, ORR, and SRS). In the event that the site boundary is less than 1,000 m from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 0.019 at ORR for the criticality accident scenario with a probability of 1.0×10^{-6} per year. The corresponding 10-year cancer facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 1,000 m (3,280 ft), would be 1.9×10^{-7} , 8.6×10^{-10} , and 3.8×10^{-9} , respectively. The maximum population 10-year facility lifetime risk would be 2.6×10^{-7} (that is, one fatality in over one million years) at ORR for the criticality accident scenario with a probability of 1.0×10^{-6} per year. The corresponding maximum offsite individual and worker 10-year facility lifetime risks would be 1.2×10^{-9} and 512×10^{-9} , respectively. The disposition of approximately 30 percent of Pu using vitrification or immobilization technologies would decrease the operational campaign length. As a result, the impacts projected for 50 t (55.1 tons) for the assumed 10-year campaign would be proportionately reduced. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.4.2.9–4 through 4.3.4.2.9–9.

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Before construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new disposition facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is a possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

An indication of the magnitude of the impacts of an aircraft crash into a disposition facility is given by the earthquake scenario. The earthquake and aircraft scenarios are similar in that they both result in major structural damage and the release of plutonium directly into the environment. They differ in that an earthquake-induced fire is based on limited combustible materials while the aircraft crash has the potential for major fuel-related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive fatal injuries.

Table 4.3.4.2.9-4. Ceramic Immobilization Alternative Accident Impacts at Hanford Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c
Earthquake	7.9x10 ⁻¹⁴ (2.8x10 ⁻¹⁴)	7.9x10 ⁻¹⁰	7.9x10 ⁻¹⁶ (2.8x10 ⁻¹⁶)	7.9x10 ⁻¹²	5.8x10 ⁻¹² (2.0x10 ⁻¹²)	5.8x10 ⁻⁸ (2.0x10 ⁻⁸)
Glovebox fire	7.9x10 ⁻¹⁴ (2.8x10 ⁻¹⁴)	7.9x10 ⁻¹⁰	7.9x10 ⁻¹⁶ (2.8x10 ⁻¹⁶)	7.9x10 ⁻¹²	5.8x10 ⁻¹² (2.0x10 ⁻¹²)	5.8x10 ⁻⁸ (2.0x10 ⁻⁸)
Glovebox criticality	1.4x10 ⁻¹⁰ (4.9x10 ⁻¹¹)	1.4x10 ⁻⁶	1.1x10 ⁻¹² (3.8x10 ⁻¹⁵)	1.2x10 ⁻⁸	1.6x10 ⁻⁹ (5.6x10 ⁻¹⁰)	1.6x10 ⁻⁵ (5.6x10 ⁻⁵)
Mixing tank criticality	1.4x10 ⁻⁹ (4.9x10 ⁻¹⁰)	1.4x10 ⁻⁵	1.1x10 ⁻¹¹ (3.8x10 ⁻¹²)	1.2x10 ⁻⁷	1.6x10 ⁻⁸ (5.6x10 ⁻⁹)	1.6x10 ⁻⁴ (5.6x10 ⁻⁴)
Bellows drop	5.8x10 ⁻¹⁵ (2.0x10 ⁻¹⁵)	5.8x10 ⁻¹³	5.5x10 ⁻¹⁷ (1.9x10 ⁻¹⁷)	5.5x10 ⁻¹⁵	4.9x10 ⁻¹³ (1.7x10 ⁻¹³)	4.9x10 ⁻¹¹ (1.7x10 ⁻¹¹)
Cesium capsule drop	1.2x10 ⁻¹¹ (4.2x10 ⁻¹²)	1.2x10 ⁻⁹	9.2x10 ⁻¹⁴ (3.2x10 ⁻¹⁴)	9.2x10 ⁻¹²	1.5x10 ⁻⁹ (5.2x10 ⁻¹⁰)	1.5x10 ⁻⁷ (5.2x10 ⁻⁷)
Plutonyl nitrate dissolver spill	1.4x10 ⁻¹⁵ (4.9x10 ⁻¹⁶)	2.7x10 ⁻¹⁵	1.4x10 ⁻¹⁷ (4.9x10 ⁻¹⁸)	2.7x10 ⁻¹⁷	9.9x10 ⁻¹⁴ (3.5x10 ⁻¹⁴)	2.0x10 ⁻¹³ (7.7x10 ⁻¹³)
Calcliner feed spill	9.2x10 ⁻¹⁵ (3.2x10 ⁻¹⁵)	1.8x10 ⁻¹⁴	8.7x10 ⁻¹⁷ (3.0x10 ⁻¹⁷)	1.7x10 ⁻¹⁶	7.7x10 ⁻¹³ (2.7x10 ⁻¹³)	1.5x10 ⁻¹² (5.2x10 ⁻¹²)

Table 4.3.4.2.9-4. Ceramic Immobilization Alternative Accident Impacts at Hanford Site—Continued

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c
Calciner product spill	2.6x10 ⁻¹² (9.1x10 ⁻¹³)	5.1x10 ⁻¹²	2.4x10 ⁻¹⁴ (8.4x10 ⁻¹⁵)	4.8x10 ⁻¹⁴	2.1x10 ⁻¹⁰ (7.3x10 ⁻¹¹)	4.3x10 ⁻¹⁰
Cesium fire	3.9x10 ⁻¹⁵ (1.4x10 ⁻¹⁵)	3.9x10 ⁻¹⁰	3.0x10 ⁻¹⁷ (1.1x10 ⁻¹⁷)	3.0x10 ⁻¹²	4.7x10 ⁻¹³ (1.6x10 ⁻¹³)	4.7x10 ⁻⁸
Process cell fire	5.7x10 ⁻¹⁶ (2.0x10 ⁻¹⁶)	5.7x10 ⁻¹¹	5.7x10 ⁻¹⁸ (2.0x10 ⁻¹⁸)	5.7x10 ⁻¹³	4.1x10 ⁻¹⁴ (1.4x10 ⁻¹⁸)	4.1x10 ⁻⁹
Criticality	4.2x10 ⁻⁹ (1.5x10 ⁻⁹)	4.2x10 ⁻⁴	4.5x10 ⁻¹¹ (1.6x10 ⁻¹¹)	3.5x10 ⁻⁶	4.8x10 ⁻⁸ (1.7x10 ⁻⁸)	4.8x10 ⁻³
Uncontrolled chemical reaction	3.7x10 ⁻¹⁶ (1.3x10 ⁻¹⁶)	3.7x10 ⁻¹¹	3.5x10 ⁻¹⁸ (1.2x10 ⁻¹⁸)	3.5x10 ⁻¹³	3.1x10 ⁻¹⁴ (1.1x10 ⁻¹⁴)	3.1x10 ⁻⁹
Expected risk ^d	5.7x10 ⁻⁹ (2.0x10 ⁻⁹)	—	4.7x10 ⁻¹¹ (1.6x10 ⁻¹¹)	—	6.7x10 ⁻⁸ (2.3x10 ⁻⁸)	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1-3, M.5.3.6.1-4 and the MACCS computer code.

Table 4.3.4.2.9-5. Ceramic Immobilization Alternative Accident Impacts at Nevada Test Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer		Risk of Cancer		Risk of Cancer	
	Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c
Earthquake	5.4x10 ⁻¹⁴ (1.9x10 ⁻¹⁴)	5.4x10 ⁻¹⁰	1.3x10 ⁻¹⁵ (4.5x10 ⁻¹⁶)	1.3x10 ⁻¹¹	1.3x10 ⁻¹³ (4.5x10 ⁻¹⁴)	1.3x10 ⁻⁹
Glovebox fire	5.4x10 ⁻¹⁴ (1.9x10 ⁻¹⁴)	5.4x10 ⁻¹⁰	1.3x10 ⁻¹⁵ (4.5x10 ⁻¹⁶)	1.3x10 ⁻¹¹	1.3x10 ⁻¹³ (4.5x10 ⁻¹⁴)	1.3x10 ⁻⁹
Glovebox criticality	1.0x10 ⁻¹⁰ (3.5x10 ⁻¹¹)	1.0x10 ⁻⁶	2.3x10 ⁻¹² (8.0x10 ⁻¹³)	2.3x10 ⁻⁸	3.3x10 ⁻¹¹ (1.1x10 ⁻¹¹)	3.3x10 ⁻⁷
Mixing tank criticality	1.0x10 ⁻⁹ (3.5x10 ⁻¹⁰)	1.0x10 ⁻⁵	2.3x10 ⁻¹¹ (8.0x10 ⁻¹²)	2.3x10 ⁻⁷	3.3x10 ⁻¹⁰ (1.1x10 ⁻¹⁰)	3.3x10 ⁻⁶
Bellows drop	4.0x10 ⁻¹⁵ (1.4x10 ⁻¹⁵)	4.0x10 ⁻¹³	8.8x10 ⁻¹⁷ (8.1x10 ⁻¹⁷)	8.8x10 ⁻¹⁵	1.1x10 ⁻¹⁴ (3.8x10 ⁻¹⁵)	1.1x10 ⁻¹²
Cesium capsule drop	8.1x10 ⁻¹² (2.8x10 ⁻¹²)	8.1x10 ⁻¹⁰	1.5x10 ⁻¹³ (5.2x10 ⁻¹⁴)	1.5x10 ⁻¹¹	3.4x10 ⁻¹¹ (1.2x10 ⁻¹¹)	3.4x10 ⁻⁹
Plutonyl nitrate dissolver spill	9.3x10 ⁻¹⁶ (3.2x10 ⁻¹⁶)	1.9x10 ⁻¹⁵	2.2x10 ⁻¹⁷ (7.7x10 ⁻¹⁸)	4.3x10 ⁻¹⁷	2.2x10 ⁻¹⁵ (7.7x10 ⁻¹⁶)	4.5x10 ⁻¹⁵
Calcliner feed spill	6.2x10 ⁻¹⁵ (2.2x10 ⁻¹⁵)	1.2x10 ⁻¹⁴	1.4x10 ⁻¹⁶ (4.9x10 ⁻¹⁷)	2.8x10 ⁻¹⁶	1.7x10 ⁻¹⁴ (5.9x10 ⁻¹⁵)	3.5x10 ⁻¹⁴
						0.05
						0.05

Table 4.3.4.2.9-5. Ceramic Immobilization Alternative Accident Impacts at Nevada Test Site—Continued

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c
Calcliner product spill	1.7x10 ⁻¹² (5.9x10 ⁻¹³)	3.5x10 ⁻¹²	3.9x10 ⁻¹⁴ (1.4x10 ⁻¹⁴)	7.7x10 ⁻¹⁴	4.9x10 ⁻¹² (1.7x10 ⁻¹²)	9.7x10 ⁻¹²
Cesium fire	2.6x10 ⁻¹⁵ (9.1x10 ⁻¹⁶)	2.6x10 ⁻¹⁰	4.9x10 ⁻¹⁷ (1.7x10 ⁻¹⁷)	4.9x10 ⁻¹²	1.1x10 ⁻¹⁴ (3.8x10 ⁻¹⁵)	1.1x10 ⁻⁹
Process cell fire	3.9x10 ⁻¹⁶ (1.4x10 ⁻¹⁶)	3.9x10 ⁻¹¹	9.0x10 ⁻¹⁸ (3.1x10 ⁻¹⁸)	9.0x10 ⁻¹³	9.3x10 ⁻¹⁶ (3.2x10 ⁻¹⁶)	9.3x10 ⁻¹¹
Criticality	3.0x10 ⁻⁹ (1.0x10 ⁻⁹)	3.0x10 ⁻⁴	6.8x10 ⁻¹¹ (2.4x10 ⁻¹¹)	6.8x10 ⁻⁶	9.7x10 ⁻¹⁰ (3.4x10 ⁻¹⁰)	9.7x10 ⁻⁵
Uncontrolled chemical reaction	2.5x10 ⁻¹⁶ (8.7x10 ⁻¹⁷)	2.5x10 ⁻¹¹	5.5x10 ⁻¹⁸ (1.9x10 ⁻¹⁸)	5.5x10 ⁻¹³	7.0x10 ⁻¹⁶ (2.4x10 ⁻¹⁶)	7.0x10 ⁻¹¹
Expected risk ^d	4.2x10 ⁻⁹ (1.5x10 ⁻⁹)	—	9.3x10 ⁻¹² (3.2x10 ⁻¹²)	—	1.4x10 ⁻⁹ (4.9x10 ⁻¹⁰)	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1-3, M.5.3.6.1-4 and the MACCS computer code.

Table 4.3.4.2.9-6. Ceramic Immobilization Alternative Accident Impacts at Idaho National Engineering Laboratory

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km -		
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c	Accident Frequency (per yr)
Earthquake	7.4x10 ⁻¹⁴ (2.6x10 ⁻¹⁴)	7.4x10 ⁻¹⁰	8.0x10 ⁻¹⁶ (2.8x10 ⁻¹⁶)	8.0x10 ⁻¹²	1.7x10 ⁻¹² (6.0x10 ⁻¹³)	1.7x10 ⁻⁸	1.0x10 ⁻⁵
Glovebox fire	7.4x10 ⁻¹⁴ (2.6x10 ⁻¹⁴)	7.4x10 ⁻¹⁰	8.0x10 ⁻¹⁶ (2.8x10 ⁻¹⁶)	8.0x10 ⁻¹²	1.7x10 ⁻¹² (6.0x10 ⁻¹³)	1.7x10 ⁻⁸	1.0x10 ⁻⁵
Glovebox criticality	1.4x10 ⁻¹⁰ (4.9x10 ⁻¹¹)	1.4x10 ⁻⁶	1.3x10 ⁻¹² (4.5x10 ⁻¹³)	1.3x10 ⁻⁸	4.3x10 ⁻¹⁰ (1.5x10 ⁻¹⁰)	4.3x10 ⁻⁶	1.0x10 ⁻⁵
Mixing tank criticality	1.4x10 ⁻⁹ (4.9x10 ⁻¹⁰)	1.4x10 ⁻⁵	1.3x10 ⁻¹¹ (4.5x10 ⁻¹²)	1.3x10 ⁻⁷	4.3x10 ⁻⁹ (1.5x10 ⁻⁹)	4.3x10 ⁻⁵	1.0x10 ⁻⁵
Bellows drop	5.4x10 ⁻¹⁵ (1.9x10 ⁻¹⁵)	5.4x10 ⁻¹³	5.5x10 ⁻¹⁷ (1.9x10 ⁻¹⁷)	5.5x10 ⁻¹⁵	1.5x10 ⁻¹³ (5.2x10 ⁻¹⁴)	1.5x10 ⁻¹¹	1.0x10 ⁻³
Cesium capsule drop	1.1x10 ⁻¹¹ (3.8x10 ⁻¹²)	1.1x10 ⁻⁹	8.8x10 ⁻¹⁴ (3.1x10 ⁻¹⁴)	8.8x10 ⁻¹²	4.6x10 ⁻¹⁰ (1.6x10 ⁻¹⁰)	4.6x10 ⁻⁸	1.0x10 ⁻³
Plutonyl nitrate dissolver spill	1.3x10 ⁻¹⁵ (4.5x10 ⁻¹⁶)	2.5x10 ⁻¹⁵	1.4x10 ⁻¹⁷ (4.9x10 ⁻¹⁸)	2.8x10 ⁻¹⁷	3.0x10 ⁻¹⁴ (1.0x10 ⁻¹⁴)	5.9x10 ⁻¹⁴	0.05
Calcliner feed spill	8.4x10 ⁻¹⁵ (2.9x10 ⁻¹³)	1.7x10 ⁻¹⁴	8.7x10 ⁻¹⁷ (3.0x10 ⁻¹⁷)	1.7x10 ⁻¹⁶	2.3x10 ⁻¹³ (8.0x10 ⁻¹⁴)	4.7x10 ⁻¹³	0.05

Table 4.3.4.2.9-6. Ceramic Immobilization Alternative Accident Impacts at Idaho National Engineering Laboratory—Continued

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c
Calcliner product spill	2.4x10 ⁻¹² (8.4x10 ⁻¹³)	4.7x10 ⁻¹²	2.4x10 ⁻¹⁴ (8.4x10 ⁻¹⁵)	4.8x10 ⁻¹⁴	6.5x10 ⁻¹¹ (2.3x10 ⁻¹¹)	1.3x10 ⁻¹⁰
Cesium fire	3.4x10 ⁻¹⁵ (1.2x10 ⁻¹⁵)	3.4x10 ⁻¹⁰	2.9x10 ⁻¹⁷ (1.0x10 ⁻¹⁷)	2.9x10 ⁻¹²	1.5x10 ⁻¹³ (5.2x10 ⁻¹⁴)	1.5x10 ⁻⁸
Process cell fire	5.3x10 ⁻¹⁶ (1.8x10 ⁻¹⁶)	5.3x10 ⁻¹¹	5.7x10 ⁻¹⁸ (2.0x10 ⁻¹⁸)	5.7x10 ⁻¹³	1.2x10 ⁻¹⁴ (4.2x10 ⁻¹⁵)	1.2x10 ⁻⁹
Criticality	4.0x10 ⁻⁹ (1.4x10 ⁻⁹)	4.0x10 ⁻⁴	4.0x10 ⁻¹¹ (1.4x10 ⁻¹¹)	4.0x10 ⁻⁶	1.3x10 ⁻⁸ (4.5x10 ⁻⁹)	1.3x10 ⁻³
Uncontrolled chemical reaction	3.4x10 ⁻¹⁶ (1.2x10 ⁻¹⁶)	3.4x10 ⁻¹¹	3.5x10 ⁻¹⁸ (1.2x10 ⁻¹⁸)	3.5x10 ⁻¹³	9.3x10 ⁻¹⁵ (3.2x10 ⁻¹⁵)	9.3x10 ⁻¹⁰
Expected risk ^d	5.6x10 ⁻⁹ (2.0x10 ⁻⁹)	—	5.5x10 ⁻¹¹ (1.9x10 ⁻¹¹)	—	1.8x10 ⁻⁹ (6.3x10 ⁻¹⁰)	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1-3, M.5.3.6.1-4 and the MACCS computer code.

Table 4.3.4.2.9-7. Ceramic Immobilization Alternative Accident Impacts at Pantex Plant

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c
Earthquake	3.2x10 ⁻¹⁴ (1.1x10 ⁻¹⁴)	3.2x10 ⁻¹⁰	9.2x10 ⁻¹⁵ (3.2x10 ⁻¹⁵)	9.2x10 ⁻¹¹ (7.0x10 ⁻¹³)	2.0x10 ⁻¹² (7.0x10 ⁻¹³)	2.0x10 ⁻⁸
Glovebox fire	3.2x10 ⁻¹⁴ (1.1x10 ⁻¹⁴)	3.2x10 ⁻¹⁰	9.2x10 ⁻¹⁵ (3.2x10 ⁻¹⁵)	9.2x10 ⁻¹¹ (7.0x10 ⁻¹³)	2.0x10 ⁻¹² (7.0x10 ⁻¹³)	2.0x10 ⁻⁸
Glovebox criticality	6.2x10 ⁻¹¹ (2.2x10 ⁻¹¹)	6.2x10 ⁻⁷	2.2x10 ⁻¹¹ (7.7x10 ⁻¹²)	2.2x10 ⁻⁷ (7.7x10 ⁻¹²)	9.5x10 ⁻¹⁰ (3.3x10 ⁻¹⁰)	9.5x10 ⁻⁶
Mixing tank criticality	6.2x10 ⁻¹⁰ (2.2x10 ⁻¹⁰)	6.2x10 ⁻⁶	2.2x10 ⁻¹⁰ (7.7x10 ⁻¹¹)	2.2x10 ⁻⁶ (7.7x10 ⁻¹¹)	9.5x10 ⁻⁹ (3.3x10 ⁻⁹)	9.5x10 ⁻⁵
Bellows drop	2.4x10 ⁻¹⁵ (8.4x10 ⁻¹⁶)	2.4x10 ⁻¹³	6.7x10 ⁻¹⁶ (2.3x10 ⁻¹⁶)	6.7x10 ⁻¹⁴ (2.3x10 ⁻¹⁶)	1.6x10 ⁻¹³ (5.6x10 ⁻¹⁴)	1.6x10 ⁻¹¹
Cesium capsule drop	5.1x10 ⁻¹² (1.8x10 ⁻¹²)	5.1x10 ⁻¹⁰	1.3x10 ⁻¹² (4.5x10 ⁻¹³)	1.3x10 ⁻¹⁰ (4.5x10 ⁻¹³)	4.4x10 ⁻¹⁰ (1.5x10 ⁻¹⁰)	4.4x10 ⁻⁸
Plutonyl nitrate dissolver spill	5.5x10 ⁻¹⁶ (1.9x10 ⁻¹⁶)	1.1x10 ⁻¹⁵	1.6x10 ⁻¹⁶ (5.6x10 ⁻¹⁷)	3.2x10 ⁻¹⁶ (5.6x10 ⁻¹⁷)	3.4x10 ⁻¹⁴ (1.2x10 ⁻¹⁴)	6.7x10 ⁻¹⁴
Calciner feed spill	3.7x10 ⁻¹⁵ (1.3x10 ⁻¹⁵)	7.5x10 ⁻¹⁵	1.1x10 ⁻¹⁵ (3.8x10 ⁻¹⁶)	2.1x10 ⁻¹⁵ (3.8x10 ⁻¹⁶)	2.5x10 ⁻¹³ (8.7x10 ⁻¹⁴)	5.0x10 ⁻¹³
						0.05
						0.05

Table 4.3.4.2.9-7. Ceramic Immobilization Alternative Accident Impacts at Pantex Plant—Continued

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c
Calcliner product spill	1.0x10 ⁻¹² (3.5x10 ⁻¹³)	2.1x10 ⁻¹²	3.0x10 ⁻¹³ (1.0x10 ⁻¹³)	5.9x10 ⁻¹³	7.0x10 ⁻¹¹ (2.4x10 ⁻¹¹)	1.4x10 ⁻¹⁰
Cesium fire	1.7x10 ⁻¹⁵ (5.9x10 ⁻¹⁶)	1.7x10 ⁻¹⁰	4.4x10 ⁻¹⁶ (1.5x10 ⁻¹⁶)	4.4x10 ⁻¹¹	1.4x10 ⁻¹³ (4.9x10 ⁻¹⁴)	1.0x10 ⁻⁶
Process cell fire	2.3x10 ⁻¹⁶ (8.0x10 ⁻¹⁷)	2.3x10 ⁻¹¹	6.6x10 ⁻¹⁷ (2.3x10 ⁻¹⁷)	6.6x10 ⁻¹²	1.4x10 ⁻¹⁴ (4.9x10 ⁻¹⁵)	1.0x10 ⁻⁶
Criticality	1.9x10 ⁻⁹ (6.6x10 ⁻¹⁰)	1.9x10 ⁻⁴	6.5x10 ⁻¹⁰ (2.3x10 ⁻¹⁰)	6.5x10 ⁻⁵	2.8x10 ⁻⁸ (9.8x10 ⁻⁹)	1.0x10 ⁻⁶
Uncontrolled chemical reaction	1.5x10 ⁻¹⁶ (5.2x10 ⁻¹⁷)	1.5x10 ⁻¹¹	4.2x10 ⁻¹⁷ (1.5x10 ⁻¹⁷)	4.2x10 ⁻¹²	1.0x10 ⁻¹⁴ (3.5x10 ⁻¹⁵)	1.0x10 ⁻⁶
Expected risk ^d	2.5x10 ⁻⁹ (8.7x10 ⁻¹⁰)	—	8.9x10 ⁻¹⁰ (3.1x10 ⁻¹⁰)	—	3.9x10 ⁻⁸ (1.4x10 ⁻⁸)	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1-3, M.5.3.6.1-4 and the MACCS computer code.

Table 4.3.4.2.9-8. Ceramic Immobilization Alternative Accident Impacts at Oak Ridge Reservation

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c
Earthquake	7.3x10 ⁻¹⁴ (2.5x10 ⁻¹⁴)	7.3x10 ⁻¹⁰	1.6x10 ⁻¹⁴ (5.6x10 ⁻¹⁵)	1.6x10 ⁻¹⁰	1.4x10 ⁻¹¹ (4.9x10 ⁻¹²)	1.4x10 ⁻⁷ 1.0x10 ⁻⁵
Glovebox fire	7.3x10 ⁻¹⁴ (2.5x10 ⁻¹⁴)	7.3x10 ⁻¹⁰	1.6x10 ⁻¹⁴ (5.6x10 ⁻¹⁵)	1.6x10 ⁻¹⁰	1.4x10 ⁻¹¹ (4.9x10 ⁻¹²)	1.4x10 ⁻⁷ 1.0x10 ⁻⁵
Glovebox criticality	1.3x10 ⁻¹⁰ (4.5x10 ⁻¹¹)	1.3x10 ⁻⁶	2.9x10 ⁻¹¹ (1.0x10 ⁻¹¹)	2.9x10 ⁻⁷	6.3x10 ⁻⁹ (2.2x10 ⁻⁹)	6.3x10 ⁻⁵ 1.0x10 ⁻⁵
Mixing tank criticality	1.3x10 ⁻⁹ (4.5x10 ⁻¹⁰)	1.3x10 ⁻⁵	2.9x10 ⁻¹⁰ (1.0x10 ⁻¹⁰)	2.9x10 ⁻⁶	6.3x10 ⁻⁸ (2.2x10 ⁻⁸)	6.3x10 ⁻⁴ 1.0x10 ⁻⁵
Bellows drop	5.5x10 ⁻¹⁵ (1.9x10 ⁻¹⁵)	5.5x10 ⁻¹³	1.2x10 ⁻¹⁵ (4.2x10 ⁻¹⁶)	1.2x10 ⁻¹³	1.1x10 ⁻¹² (3.8x10 ⁻¹³)	1.1x10 ⁻¹⁰ 1.0x10 ⁻³
Cesium capsule drop	1.2x10 ⁻¹¹ (4.2x10 ⁻¹²)	1.2x10 ⁻⁹	2.4x10 ⁻¹² (8.4x10 ⁻¹³)	2.4x10 ⁻¹⁰	3.1x10 ⁻⁹ (1.1x10 ⁻⁹)	3.1x10 ⁻⁷ 1.0x10 ⁻³
Plutonyl nitrate dissolver spill	1.3x10 ⁻¹⁵ (4.5x10 ⁻¹⁶)	2.5x10 ⁻¹⁵	2.8x10 ⁻¹⁶ (9.8x10 ⁻¹⁷)	5.7x10 ⁻¹⁶	2.4x10 ⁻¹³ (8.4x10 ⁻¹⁴)	4.8x10 ⁻¹³ 0.05
Calcliner feed spill	8.6x10 ⁻¹⁵ (3.0x10 ⁻¹⁵)	1.7x10 ⁻¹⁴	1.8x10 ⁻¹⁵ (6.3x10 ⁻¹⁶)	3.7x10 ⁻¹⁵	1.8x10 ⁻¹² (6.3x10 ⁻¹³)	3.5x10 ⁻¹² 0.05

Table 4.3.4.2.9-8. Ceramic Immobilization Alternative Accident Impacts at Oak Ridge Reservation—Continued

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c
Calciner product spill	2.4x10 ⁻¹² (8.4x10 ⁻¹³)	4.8x10 ⁻¹²	5.2x10 ⁻¹³ (1.8x10 ⁻¹³)	1.0x10 ⁻¹²	4.9x10 ⁻¹⁰ (1.7x10 ⁻¹⁰)	9.9x10 ⁻¹⁰
Cesium fire	3.8x10 ⁻¹⁵ (1.3x10 ⁻¹⁵)	3.8x10 ⁻¹⁰	7.7x10 ⁻¹⁶ (2.7x10 ⁻¹⁶)	7.7x10 ⁻¹¹	9.9x10 ⁻¹³ (3.5x10 ⁻¹³)	9.9x10 ⁻⁸
Process cell fire	5.3x10 ⁻¹⁶ (1.8x10 ⁻¹⁶)	5.3x10 ⁻¹¹	1.2x10 ⁻¹⁶ (4.2x10 ⁻¹⁷)	1.2x10 ⁻¹¹	1.0x10 ⁻¹³ (3.5x10 ⁻¹⁴)	1.0x10 ⁻⁸
Criticality	3.8x10 ⁻⁹ (1.3x10 ⁻⁹)	3.8x10 ⁻⁴	8.6x10 ⁻¹⁰ (3.0x10 ⁻¹⁰)	8.6x10 ⁻⁵	1.9x10 ⁻⁷ (6.6x10 ⁻⁸)	0.019
Uncontrolled chemical reaction	3.4x10 ⁻¹⁶ (1.2x10 ⁻¹⁶)	3.4x10 ⁻¹¹	7.4x10 ⁻¹⁷ (2.6x10 ⁻¹⁷)	7.4x10 ⁻¹²	7.1x10 ⁻¹⁴ (2.5x10 ⁻¹⁴)	7.1x10 ⁻⁹
Expected risk ^d	5.2x10 ⁻⁹ (1.8x10 ⁻⁹)	—	1.2x10 ⁻⁹ (4.2x10 ⁻¹⁰)	—	2.6x10 ⁻⁷ (9.1x10 ⁻⁸)	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1-3, M.5.3.6.1-4 and the MACCS computer code.

Table 4.3.4.2.9-9. Ceramic Immobilization Alternative Accident Impacts at Savannah River Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km		Accident Frequency (per yr)
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c	
Earthquake	5.2x10 ⁻¹⁴ (1.8x10 ⁻¹⁴)	5.2x10 ⁻¹⁰	1.3x10 ⁻¹⁵ (4.5x10 ⁻¹⁶)	1.3x10 ⁻¹¹	6.2x10 ⁻¹² (2.2x10 ⁻¹²)	6.2x10 ⁻⁸	1.0x10 ⁻⁵
Glovebox fire	5.2x10 ⁻¹⁴ (1.8x10 ⁻¹⁴)	5.2x10 ⁻¹⁰	1.3x10 ⁻¹⁵ (4.5x10 ⁻¹⁶)	1.3x10 ⁻¹¹	6.2x10 ⁻¹² (2.2x10 ⁻¹²)	6.2x10 ⁻⁸	1.0x10 ⁻⁵
Glovebox criticality	9.1x10 ⁻¹¹ (3.2x10 ⁻¹¹)	9.1x10 ⁻⁷	2.0x10 ⁻¹² (7.0x10 ⁻¹³)	2.0x10 ⁻⁸	2.0x10 ⁻⁹ (7.0x10 ⁻¹⁰)	2.0x10 ⁻⁵	1.0x10 ⁻⁵
Mixing tank criticality	9.1x10 ⁻¹⁰ (3.2x10 ⁻¹⁰)	9.1x10 ⁻⁶	2.0x10 ⁻¹¹ (7.0x10 ⁻¹²)	2.0x10 ⁻⁷	2.0x10 ⁻⁸ (7.0x10 ⁻⁹)	2.0x10 ⁻⁴	1.0x10 ⁻⁵
Bellows drop	3.9x10 ⁻¹⁵ (1.4x10 ⁻¹⁵)	3.9x10 ⁻¹³	9.3x10 ⁻¹⁷ (3.2x10 ⁻¹⁷)	9.3x10 ⁻¹⁵	5.1x10 ⁻¹³ (1.8x10 ⁻¹³)	5.1x10 ⁻¹¹	1.0x10 ⁻³
Cesium capsule drop	8.4x10 ⁻¹² (2.9x10 ⁻¹²)	8.4x10 ⁻¹⁰	1.9x10 ⁻¹³ (6.6x10 ⁻¹⁴)	1.9x10 ⁻¹¹	1.5x10 ⁻⁹ (5.2x10 ⁻¹⁰)	1.5x10 ⁻⁷	1.0x10 ⁻³
Plutonyl nitrate dissolver spill	8.9x10 ⁻¹⁶ (3.1x10 ⁻¹⁶)	1.8x10 ⁻¹⁵	2.2x10 ⁻¹⁷ (7.7x10 ⁻¹⁸)	4.4x10 ⁻¹⁷	1.1x10 ⁻¹³ (3.8x10 ⁻¹⁴)	2.1x10 ⁻¹³	0.05
Calcliner feed spill	6.1x10 ⁻¹⁵ (2.1x10 ⁻¹⁵)	1.2x10 ⁻¹⁴	1.5x10 ⁻¹⁶ (5.2x10 ⁻¹⁷)	2.9x10 ⁻¹⁶	8.1x10 ⁻¹³ (2.8x10 ⁻¹³)	1.6x10 ⁻¹²	0.05

Table 4.3.4.2.9-9. Ceramic Immobilization Alternative Accident Impacts at Savannah River Site—Continued

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^b	Risk of Cancer Fatality per 10 yr (per 3.5 yr) ^a	Probability of Cancer Fatalities ^c
Calciner product spill	1.7x10 ⁻¹² (5.9x10 ⁻¹³)	3.4x10 ⁻¹²	4.1x10 ⁻¹⁴ (1.4x10 ⁻¹⁴)	8.2x10 ⁻¹⁴	2.2x10 ⁻¹⁰ (7.7x10 ⁻¹¹)	4.5x10 ⁻¹⁰
Cesium fire	2.7x10 ⁻¹⁵ (9.4x10 ⁻¹⁶)	2.7x10 ⁻¹⁰	6.1x10 ⁻¹⁸ (2.1x10 ⁻¹⁸)	6.1x10 ⁻¹²	4.7x10 ⁻¹³ (1.6x10 ⁻¹³)	4.7x10 ⁻⁸
Process cell fire	3.7x10 ⁻¹⁶ (1.3x10 ⁻¹⁶)	3.7x10 ⁻¹¹	9.1x10 ⁻¹⁸ (3.2x10 ⁻¹⁸)	9.1x10 ⁻¹³	4.4x10 ⁻¹⁴ (1.5x10 ⁻¹⁴)	4.4x10 ⁻⁹
Criticality	2.7x10 ⁻⁹ (9.4x10 ⁻¹⁰)	2.7x10 ⁻⁴	6.0x10 ⁻¹¹ (2.1x10 ⁻¹¹)	6.0x10 ⁻⁶	6.1x10 ⁻⁸ (2.1x10 ⁻⁸)	6.1x10 ⁻³
Uncontrolled chemical reaction	2.4x10 ⁻¹⁶ (8.4x10 ⁻¹⁷)	2.4x10 ⁻¹¹	5.9x10 ⁻¹⁸ (2.1x10 ⁻¹⁸)	5.9x10 ⁻¹³	3.2x10 ⁻¹⁴ (1.1x10 ⁻¹⁴)	3.2x10 ⁻⁹
Expected risk ^d	3.7x10 ⁻⁹ (1.3x10 ⁻⁹)	—	8.3x10 ⁻¹¹ (2.9x10 ⁻¹¹)	—	8.5x10 ⁻⁸ (3.0x10 ⁻⁸)	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. For the Preferred Alternative for analysis purposes approximately 30 percent of Pu was assumed for vitrification or immobilization technologies and the operational campaign would decrease. As a result, the impacts projected for 50 t for the assumed 10-year campaign would be proportionately reduced for a 3.5-year campaign.

Source: Calculated using the source terms in Tables M.5.3.6.1-3, M.5.3.6.1-4 and the MACCS computer code.

4.3.4.2.10 Waste Management

This section summarizes the waste management impacts for the construction and operation of a ceramic immobilization facility. There is no spent nuclear fuel or HLW associated with the operation of the ceramic immobilization facility; however, the facility does generate as its product output a stabilized ceramic form spiked with cesium radionuclides that would require interim storage. The ceramic immobilization facility would provide the necessary storage of the immobilized Pu in ceramic form until entry into the Federal Waste Management System for final disposition. Table 4.3.4.2.10-1 provides the estimated operational waste volumes projected to be generated at the sites analyzed as a result of the ceramic immobilization facility. Facilities that would support the ceramic immobilization facility would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS wastes could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the ceramic immobilization facility and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.5. A detailed description of the waste management activities that would be required to support the ceramic immobilization facility can also be found in Section E.3.3.5.

Construction and operation of a ceramic immobilization facility would impact existing waste management activities at each of the sites analyzed, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater and solid nonhazardous and hazardous wastes. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to a commercial RCRA-permitted treatment and disposal facility. No soil contaminated with hazardous or radioactive constituents is expected to be generated

Table 4.3.4.2.10-1. Estimated Annual Generated Waste Volumes for the Ceramic Immobilization Alternative^a

Category	New Facility (m ³)	Hanford	NTS	INEL	Pantex	ORR	SRS
		No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)
Transuranic							
Liquid	75 ^b	None	None	None	None	None	None
Solid	99	271	None	3.5	None	119	338
Mixed Transuranic							
Liquid	0	None	None	None	None	None	None
Solid	0.7	98	None	Included in TRU	None	None	Included in TRU
Low-Level							
Liquid	7 ^b	None	Dependent on restoration activities	None	8	2,970	74,000
Solid	14	3,390	15,000	7,200	32	7,320	16,400
Mixed Low-Level							
Liquid	0	3,760	None	4	4	87,600	1,330
Solid	0.15	1,505	50	170	46	432	7,700

Table 4.3.4.2.10-1. Estimated Annual Generated Waste Volumes for the Ceramic Immobilization Alternative^a—Continued

Category	New Facility (m ³)	Hanford	NTS	INEL	Pantex	ORR	SRS
		No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)
Hazardous							
Liquid	38	Included in solid	Included in solid	Included in solid	2	6,460	1,260
Solid	19	560	212	1,200	31	26	15,100
Nonhazardous (Sanitary)							
Liquid	34,000	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000
Solid	920	5,107	2,120	52,000	339	53,100	61,200
Nonhazardous (Other)							
Liquid	170,000	Included in sanitary	Included in sanitary	None	Included in sanitary	650,000	Included in sanitary
Solid	15 ^c	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary

^a The No Action volumes are from Tables 4.2.1.10-1, 4.2.2.10-1, 4.2.3.10-1, 4.2.4.10-1, 4.2.5.10-1, and 4.2.6.10-1. Incremental waste generation volumes for ceramic immobilization facility are from Table E.3.3.5-1. Waste effluent volumes (that is, after treatment and volume reduction) which are used in the narrative description of the impacts are also provided in Table E.3.3.5-1.

^b Liquid TRU and LLW would be treated and solidified prior to disposal.

^c Recyclable wastes.

during construction. However, if any contaminated soil is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

Following treatment and volume reduction, approximately 99 m³ (130 yd³) of TRU waste consisting of job-control waste (protective clothing and radiological survey waste), HEPA filters, resins, and sludge from liquid TRU treatment would require treatment and repackaging to meet the current planning-basis WIPP WAC or alternative treatment level. Hanford, INEL, and SRS have existing and planned TRU waste facilities that could be utilized. Due to their limited capability to process, package, and store TRU waste, a radwaste facility would need to be constructed as part of the ceramic immobilization facility if sited at ORR, Pantex, and NTS. A small quantity (0.7 m³ [0.9 yd³]) of mixed TRU waste would require processing and packaging to meet the current planning-basis WIPP WAC of alternative treatment level. Mixed TRU waste would be generated if a TRU waste stream became contaminated with a hazardous waste constituent. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), 12 additional truck shipments per year or, if applicable, 6 regular train shipments per year or 2 dedicated train shipments per year would be required. [Text deleted.]

All of the sites analyzed have existing or planned facilities that could manage the small quantities of LLW. After treatment and volume reduction, approximately 11 m³ (14 yd³) of LLW from solidified liquid LLW, protective clothing, soil, and small equipment would require disposal. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.003 ha/yr (0.008 acres/yr) at Hanford and ORR, 0.002 ha/yr (0.004 acres/yr) at NTS and INEL, and 0.001 ha/year (0.003 acres/yr) at SRS. With no onsite LLW disposal

capability, Pantex would require one additional LLW shipment per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

A small quantity (0.15 m^3 [0.2 yd^3]) of solid mixed LLW consisting of contaminated solvent rags and equipment that have been contaminated with both radioactive and hazardous constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the Tri-Party Agreement for Hanford and the respective site treatment plan that was developed to comply with the *Federal Facility Compliance Act* for the remainder of the sites analyzed.

An estimated 38 m^3 (10,000 gal) of liquid and 19 m^3 (25 yd^3) of solid hazardous wastes would be generated annually. Hazardous wastes would consist primarily of analytical solutions and solvent rags contaminated with methylene chloride, acetonitrile, and acetone. Other hazardous wastes would include paint solvents, various laboratory chemicals, and organic waste from nonradioactive testing. Hazardous wastes would be staged in RCRA-permitted facilities until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

Approximately $34,000 \text{ m}^3$ (9 million gal) of liquid nonhazardous sanitary and industrial wastewater and $170,000 \text{ m}^3$ (45 million gal) of steam plant blowdown and estimated stormwater runoff would require treatment in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems may be required for some of the DOE sites. The Preferred Alternative, construction of sanitary, utility, and process wastewater treatment systems may not be required because approximately 30 percent of the surplus Pu would be immobilized. The construction of these treatments systems would be determined in further tiered NEPA documentation. The 920 m^3 ($1,200 \text{ yd}^3$) of solid nonhazardous wastes such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

4.3.4.3 Electrometallurgical Treatment Alternative

The environmental impacts described in the following sections are based on the analysis of the electrometallurgical treatment facility described in Section 2.4.4.3. The ANL-W at INEL is used as a representative site for this alternative. If this alternative is selected in the ROD and if a different site were ultimately selected, the impacts described in this section could be different. With respect to public and occupational health and safety, and waste, these impacts are not anticipated to differ significantly from those discussed in this section. DOE would analyze such different impacts in subsequent tiered, site-specific NEPA documentation if this alternative were selected.

4.3.4.3.1 Land Resources

Land Use. As discussed in Section 4.3.4.3.2, the Pu disposition effort would require the installation of additional equipment within existing buildings, however, no major modifications are anticipated. Therefore, no additional land area would be disturbed, used during operations, or required for a buffer zone. Utilization of existing facilities would not change land use and the alternative would likely be consistent with existing site use. Therefore, there would be no direct land use impacts during operations.

Operation of the facility would likely be consistent with Federal and local land-use plans, policies, and controls. Other onsite or offsite land uses would not be affected. Prime farmlands would not be affected. As discussed in Section 4.3.4.3.8, no in-migration would be anticipated during operations. Therefore, no indirect impacts to offsite land use would occur.

Visual Resources. There would be no new impacts to visual resources caused by operations. The visual environment would be consistent with the existing industrialized landscape character. The alternative would be anticipated to be consistent with the current VRM designation of the developed area of the site, likely a Class 5.

4.3.4.3.2 Site Infrastructure

The existing site infrastructure resources at the INEL site, and in particular the ANL-W facilities, are considered adequate to accommodate Pu disposition. The Pu disposition effort would require the use of some equipment that is not currently installed in existing buildings. The power and fuel resources that would be required to install this equipment are shown in Appendix C. No major modifications to existing facilities are anticipated due the addition of Pu disposition activities.

The site infrastructure resources to be utilized during operation of the electrometallurgical treatment process are presented in Appendix C. As shown in Table 4.3.4.3.2-1, the effect of this added resource consumption would be within the capacity available at INEL.

Table 4.3.4.3.2-1. Additional Site Infrastructure Needed for the Operation of the Electrometallurgical Treatment Alternative at Idaho National Engineering Laboratory (Annual)^a

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	0	0	2,400	0.008	0	0	0
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage (without facility)	445	48	232,500	42	5,820,000	0	11,340
Projected usage (with facility)	445	48	234,900	42	5,820,000	0	11,340
Amount required in excess to site availability	0	0	0	0	0	0	0

^a Values in this table represent the incremental site infrastructure values allocated to operating this alternative at INEL.
Source: INEL 1995a:1; LLNL 1996b.

4.3.4.3.3 Air Quality and Noise

Air quality or noise effects from the required facility modifications for electrometallurgical treatment would be localized, short-term, and minor. Operation of this facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines. Impacts from radiological airborne emissions are discussed in Section 4.3.4.3.9.

Due to the limited additional equipment required for Pu disposition activities, incremental noise impacts during operation are expected to be low relative to sitewide baseline operations for INEL. Air quality and noise impacts for this facility are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

The electrometallurgical treatment would result in the emission of some criteria pollutants. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

Emission rates for operation of the electrometallurgical treatment facility are presented in Table F.1.3–11. Air pollutant emissions sources associated with operations include the following:

- Increased operation of existing boilers or operation of new boilers for space heating
- Operation of diesel generators and periodic testing of emergency diesel generators
- [Text deleted.]
- Small quantities of toxic/hazardous pollutant emissions from facility processes and laboratories

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations for operation of this facility plus the No Action concentrations are presented in Table 4.3.4.3.3–1. Pollutant concentrations, combined with No Action, would be in compliance with Federal and State standards. VOCs are the only toxic/hazardous emissions and were not modeled for this PEIS.

NOISE

The location of the ANL-W facilities relative to the site boundary and sensitive receptors was examined to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during facility modifications and operations may include slightly increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring materials, equipment and workers to the site.

Nontraffic noise sources associated with operation of this alternative facility include ventilation systems, diesel generators and other sources. These noise sources are located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the site, noise emissions from equipment and other site operations would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

Table 4.3.4.3.3-1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Electrometallurgical Treatment Alternative and No Action Alternative

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines ^a (µg/m ³)	INEL	
			No Action (µg/m ³)	Total (µg/m ³)
Criteria Pollutants				
Carbon monoxide	8-hour	10,000	284	284
	1-hour	40,000	614	614
Lead	Calendar Quarter	1.5	0.001	0.001
Nitrogen dioxide	Annual	100	4	4
Ozone	1-hour	235	b	b
Particulate matter less than or equal to 10 microns in diameter	Annual	50	5	5
	24-hour	150	80	80
Sulfur dioxide	Annual	80	6	6
	24-hour	365	135	135
	3-hour	1,300	579	579
Mandated by Idaho				
Total suspended particulates	Annual	60	5	5
	24-hour	150	80	80
Hazardous and Other Toxic Compounds ^c	-	-	-	-

^a The more stringent of the Federal and State standard is presented if both exist for the averaging time.

^b Ozone, as a criteria pollutant is not directly emitted nor monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

^c Emissions of volatile organic compounds were not modeled.

[Text deleted.]

Note: Total concentrations are based on site contribution, including concentrations from ongoing activities (No Action), and do not include the contribution from non-facility sources. Concentrations for other hazardous/toxic pollutants reported for No Action in Section 4.2 are unchanged for this alternative and are not shown here.

Source: 40 CFR 50; ID DHW 1995a; ID DHW 1995b; LLNL 1996b.

4.3.4.3.4 Water Resources

Water resource requirements and discharges provided in Tables C.1.1.3–6 and C.2.1.3–6 and Table E.3.3.6–1 were used to assess impacts to surface water and groundwater.

Surface Water. No surface water would be withdrawn for any facility modifications or operational activities associated with the electrometallurgical facility; consequently, no impacts to surface water availability or surface water quality are expected. [Text deleted.]

During operation, no effluent would be discharged to natural surface waters. Sanitary wastewater from the facility would be treated prior to discharge to lined evaporation ponds. However, cooling system blowdown and nonhazardous industrial wastewater would be discharged to the industrial waste pond. Treated effluents would be monitored to comply with discharge requirements. The extent to which treated effluent or stormwater would be recycled for reuse within the plant would be determined during site-specific studies.

The facility for the proposed electrometallurgical demonstration is located outside the flood zone of the Big Lost River that could develop as a result of the failure of MacKay Dam during a probable maximum flood. The flood event would be more critical than either the 100- or 500-year floodplain.

Groundwater. Groundwater required to support site activities during facility modifications (15 million l/yr [4 million gal/yr]) would represent approximately a 0.02-percent maximum increase over the projected groundwater withdrawal, and would be less than 0.003-percent of INEL current allotment. Thus, no additional allotments or permits would be required; it would not cause depletion of the aquifer or affect recharge. Groundwater required during operation of the facility (17.4 million l/yr [4.6 million gal/yr]) would be less than 0.04-percent of INEL's current allotment. As discussed in Section 3.4.4, a groundwater allotment, not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). Operating an electrometallurgical facility would not exceed current groundwater allotments.

During construction, no water would be discharged directly to the environment and thus would not be expected to contribute to existing near-surface contamination. During operation, sanitary wastewater would be treated and discharged to evaporation ponds. Therefore, no impacts to ground water quality would be anticipated.

4.3.4.3.5 *Geology and Soils*

The ANL-W at INEL is used as a representative site for this alternative. If this alternative is selected in the ROD, construction would be required for any site other than INEL. Additional tiered NEPA documentation would be completed, as appropriate.

As discussed in Section 4.3.4.3.2, the Electrometallurgical Treatment Alternative could be implemented at INEL utilizing existing site infrastructure. The Pu disposition effort would require the installation of additional equipment within existing buildings; however, no major modifications are anticipated. As a result, no new ground-breaking construction activities would be associated for this alternative. Therefore, no construction or operational impacts to geologic and soil resources are anticipated and no direct or indirect impacts to geologic or soil resources are anticipated.

4.3.4.3.6 *Biological Resources*

For analytical purposes it is assumed that immobilization of surplus Pu through electrometallurgical treatment would take place within existing facilities at ANL-W. Since existing facilities would be used, including those for wastewater treatment, no additional disturbance of land area or habitat would occur, and impacts to biological resources at INEL would not be expected.

4.3.4.3.7 *Cultural and Paleontological Resources*

No new construction would be required for the electrometallurgical treatment alternative and only minor modifications would be required for the HFEF and the ZPPR. Both of these structures were built in the 1970s, and the FCF was refurbished and upgraded in 1994. None of these facilities are NRHP eligible. No acreage would be disturbed if this alternative is chosen. Therefore, no cultural or paleontological resources would be affected.

4.3.4.3.8 Socioeconomics

This section analyzes the socioeconomic effects of the electrometallurgical facility for INEL. The effects at INEL are found in the Supplemental Socioeconomic Data Report (Socio 1996a).

Regional Economy Characteristics. Construction is not required for this alternative. The electrometallurgical facility's operation would require an additional 83 workers. Operating this facility would generate an additional 223 indirect jobs in the INEL REA. Unemployment would drop to 5.2 percent from the No Action projection of 5.4 percent during operation. These new jobs would be filled by workers from within the region. Operation of the electrometallurgical facility at INEL would very slightly increase regional per capita income above the No Action projection.

Population and Housing, Community Services, and Local Transportation. The new jobs would be filled by the existing regional labor force, and there would be no project-related population impacts on housing, community services, or local transportation beyond the No Action projections.

4.3.4.3.9 Public and Occupational Health and Safety

This section describes the radiological and hazardous chemical releases and their associated health and safety impacts resulting from either normal operations or accidents involved with the immobilization of Pu using the electrometallurgical treatment. The section first describes the impacts from normal facility operation at the INEL site, followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation during the assumed 10-year campaign time are presented in Tables 4.3.4.3.9-1 and 4.3.4.3.9-2, respectively. Impacts from hazardous chemicals to these same groups are given in Table 4.3.4.3.9-3. Additional information is provided in Appendix M.

Normal Operation. There would be no radiological releases associated with modifying the facility for the treatment of Pu. Workers involved with the modifications would be limited in their exposure to material potentially contaminated with radioactivity. This would assure that their doses are maintained as low as reasonably achievable. Towards this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as the result of activities associated with the installation of additional equipment. Onsite and offsite concentrations resulting from releases would be within the regulated exposure limits.

During the normal operation of the treatment process to immobilize the Pu, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the treatment process to immobilize Pu are presented in Table 4.3.4.3.9-1. The impacts from all site operations, including the treatment process, are also given. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The dose to the maximally exposed member of the public from annual operation of the electrometallurgical treatment process would be 7.6×10^{-4} mrem. The associated fatal cancer risk to this individual from 10 years of operation would be 3.8×10^{-9} . The impacts to the average individual would be even smaller. The annual dose to the population within 80 km (50 mi) would be 0.016 person-rem, which could result in 8.0×10^{-5} fatal cancers in this population from 10 years of operation.

The dose to the maximally exposed member of the public from annual total site operations would be maintained within the radiological limits specified by NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would be 0.019 mrem. From 10 years of operation, the corresponding risk of fatal cancers to this individual would be 9.5×10^{-8} . The impacts to the average individual would be even smaller. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of total site operations, the annual population dose would be within the limit in proposed 10 CFR 834, and would be 2.4 person-rem. The corresponding number of potential fatal cancers in this population from 10 years of operation would be 0.012.

Doses to onsite workers from normal operations are given in Table 4.3.4.3.9-2. Included are involved workers directly associated with the electrometallurgical treatment of Pu, noninvolved workers, and the entire workforce at INEL. All doses fall within regulatory limits.

The annual dose to the average worker involved with the electrometallurgical treatment of Pu would be 40 mrem; the dose to the entire Pu treatment workforce would be 2.9 person-rem. The annual dose to the total

Table 4.3.4.3.9-1. Potential Radiological Impacts to the Public During Normal Operation of the Electrometallurgical Treatment Alternative at Idaho National Engineering Laboratory

Receptor	Electrometallurgical Treatment Facility	Total Site ^a
Annual Dose to the Maximally Exposed Individual Member of the Public^b		
Atmospheric release pathway (mrem)	7.6×10^{-4}	0.019
Drinking water pathway (mrem)	0	0
Total liquid release pathway (mrem)	0	0
Atmospheric and liquid release pathways combined (mrem)	7.6×10^{-4}	0.019
Percent of natural background ^c	2.2×10^{-4}	5.6×10^{-3}
10-year fatal cancer risk	3.8×10^{-9}	9.5×10^{-8}
Annual Population Dose Within 80 Kilometers^d		
Atmospheric release pathway (person-rem)	0.016	2.4
Total liquid release pathway (person-rem)	0	0
Atmospheric and liquid release pathways combined (person-rem)	0.016	2.4
Percent of natural background ^c	3.1×10^{-5}	4.7×10^{-3}
10-year fatal cancers	8.0×10^{-5}	0.012
Annual Dose to the Average Individual Within 80 Kilometers^e		
Atmospheric and liquid release pathways combined (mrem)	1.1×10^{-4}	0.016
10-year fatal cancer risk	5.5×10^{-10}	8.0×10^{-8}

^a Includes impacts from No Action facilities. The location of the MEI may be different under No Action than for operation of the electrometallurgical treatment process. Therefore, the impacts may not be directly additive.

^b The applicable radiological limits for an individual member of the public from total site operation are 10 mrem from the air pathways, as required by the NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

^c The annual natural background radiation level at INEL is 338 for the average individual; the population within 80 km receives 90,800 person-rem.

^d For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

^e Obtained by dividing the population dose by the number of people projected to live within 80 km of INEL (269,000).

Note: Impacts from the electrometallurgical treatment are assumed to be 20 percent of the impacts associated with ANL-W. This is based on an estimate of the additional amount of material that would have to be processed by the electrometallurgical treatment facility to accommodate the immobilization of the Pu under this alternative.

Source: LLNL 1996b and model results (refer to Section M.2).

site workforce would be 223 person-rem. The risks and numbers of fatal cancers among the different workers from 10 years of operation are included in Table 4.3.4.3.9-2.

Hazardous Chemical Impacts. The hazardous chemical impacts from normal operation of the electrometallurgical treatment subalternative at INEL are presented in Table 4.3.4.3.9-3. Included are the impacts due to operation of the electrometallurgical treatment facility only to immobilize Pu, and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected, and the risk of cancer due to the total chemical exposures. All supporting impact analyses are provided in Section M.3.

The HI to the MEI due to the facility operation would be 1.8×10^{-6} at INEL. The cancer risk from hazardous chemicals to the MEI would be zero (because no carcinogens are released from hazardous chemicals) at INEL.

Table 4.3.4.3.9-2. Potential Radiological Impacts to Workers During Normal Operation of the Electrometallurgical Treatment at Idaho National Engineering Laboratory

Receptor	Impact
Involved Workforce^a	
Average worker dose (mrem/yr) ^b	40
10-year risk of fatal cancer	1.6x10 ⁻⁴
Total dose (person-rem/yr)	2.9
10-year fatal cancers	0.012
Noninvolved Workforce^c	
Average worker dose (mrem/yr) ^b	30
10-year risk of fatal cancer	1.2x10 ⁻⁴
Total dose (person-rem/yr)	220
10-year fatal cancers	0.88
Total Site Workforce^d	
Dose (person-rem/yr)	223
10-year fatal cancers	0.89

^a The involved worker is a worker associated with operations of the electrometallurgical treatment process to immobilize Pu.

^b The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

^c The noninvolved worker is a worker onsite but not associated with electrometallurgical treatment operations. The noninvolved workforce is equivalent to the No Action workforce.

^d The impact to the total workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: LLNL 1996b.

Table 4.3.4.3.9-3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Electrometallurgical Treatment Alternative at Idaho National Engineering Laboratory

Receptor	INEL	
	Facility ^a	Total Site ^b
Maximally Exposed Individual (Public)		
Hazard index ^c	1.8x10 ⁻⁶	0.015
Cancer risk ^d	0	3.6x10 ⁻⁶
Worker Onsite		
Hazard index ^e	1.6x10 ⁻⁵	0.22
Cancer risk ^f	0	7.7x10 ⁻⁴

^a Facility=Contribution from the proposed new facility operation only.

^b Total=Includes the contributions from the No Action and the proposed new facility operation.

^c Hazard Index for MEI=Sum of Individual Hazard Quotients (noncancer health effects) for MEI.

^d Cancer Risk for MEI=(Emissions Concentrations) x (0.286[converts concentrations to doses]) x (Slope Factor (SF)). Where there are no known carcinogens among chemicals emitted, the cancer risk value is 0.

^e Hazard Index for Workers=Sum of Individual Hazard Quotients (noncancer health effects) for workers.

^f Cancer Risk for Workers=(Emissions for 8-hr) x (0.286[converts concentrations to doses]) x (0.237[Fraction of year exposed]) x (0.571[Fraction of lifetime working]) x (Slope Factor). Where there are no known carcinogens among chemicals emitted, there are no slope factors; therefore, the calculated cancer risk value is 0.

Source: Section M.3, Table M.3.4-60.

The HI to the onsite worker would be 1.6×10^{-5} at INEL, and the cancer risk to the onsite worker would be zero (because no carcinogens are released from hazardous chemicals) at INEL. The total HI to the MEI is 1.5×10^{-2} and to the workers is 0.22. The total cancer risk to the MEI is 3.6×10^{-6} and to the workers is 7.7×10^{-4} .

Facility Accidents. Potential accidents associated with electrometallurgical treatment at the FCF at INEL have been analyzed and documented in an Environmental Assessment (IN DOE 1996c:83-94). The analysis includes both design-basis and beyond design-basis accidents associated with the treatment of spent nuclear fuels but does not explicitly analyze the effects of integrating plutonium in with the spent fuel being processed. Since the FCF is used for the treatment of a variety of DOE reactor fuels, many process uncertainties exist; these include the types and quantities of materials at risk within the argon cell. As a result, the safety analyses are based on conservative assumptions that are expected to bound any campaign that may be conducted during the DOE spent fuel treatment program. For comparison, the materials-at-risk considered for the FCF SAR (IN ANL 1995a:Ch 9) and addressed in the EA and another study on the immobilization of surplus fissile material through electrometallurgical treatment of spent fuel (LLNL 1996b:8-1) are based on a process for the treatment of EBR-II fuel. This provides a basis for extrapolation of the accident consequences for the proposed surplus plutonium immobilization program since the electrometallurgical processes are essentially the same and the bounding accidents evolve in the same way. The processes to produce metal immobilization forms (bounding case) are considered in these analyses, because they result in the largest accident impacts attributable to immobilization operations (LLNL 1996b:8-1).

The accidents analyzed in the FCF SAR were screened using three criteria (LLNL 1996b:8-3) to select a subset of accidents that would reflect the additional risk associated with surplus Pu immobilization program. The accident in the subset with the highest impacts is a breach in the argon cell that would be initiated by a design-basis earthquake. This accident has an estimated probability in the range 1.0×10^{-6} to 1.0×10^{-4} per year and, if it were to occur, would result in a 5.2×10^{-7} increased likelihood of latent cancer fatality to an uninvolved worker located about 230 m (750 ft) from the accident. For the MEI, the accident would result in a 3.5×10^{-8} increased likelihood of latent cancer fatality and a corresponding risk over the 10-year campaign of 3.5×10^{-11} . The estimated number of latent cancer fatalities in the offset population within 80 km (50 mi) would be 3.7×10^{-6} and the corresponding risk of latent cancer fatalities over a 10-year campaign would be 3.7×10^{-9} (IN DOE 1996c:89-90).

The beyond design-basis accident with the highest impacts would be a metal fire due to an earthquake induced breach in the argon cell concurrent with HEPA filter failure and an unfiltered release. This scenario is similar to the design-basis accident with the highest impacts except in this more severe accident, the release to the environment is unfiltered. This accident has an estimated probability of 1.0×10^{-6} per year or less and, if it occurred, would result in a 5.2×10^{-3} increased likelihood of latent cancer fatality to a worker located about 230 m (750 ft) from the accident. For the MEI, the accident would result in a 3.5×10^{-4} increased likelihood of latent cancer fatality and a corresponding risk over the 10-year campaign of 3.5×10^{-9} . The estimated number of latent cancer fatalities in the offsite population within 80 km (50 mi) would be 0.037 and the corresponding risk of latent cancer fatalities over a 10-year campaign would be 3.7×10^{-7} (IN DOE 1996c:91-93).

4.3.4.3.10 Waste Management

This section summarizes the waste management impacts for the construction and operation of electrometallurgical treatment for the immobilization of surplus fissile material in existing ANL-W facilities at INEL. Table 4.3.4.3.10–1 provides the estimated operational waste volumes projected to be generated at INEL, as a result of the electrometallurgical treatment of surplus fissile material. Facilities that would support the electrometallurgical treatment facility would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the electrometallurgical treatment facility

Table 4.3.4.3.10–1. Estimated Annual Generated Waste Volumes for the Electrometallurgical Treatment Alternative

Category	INEL	
	No Action ^a (m ³)	Pu Disposition (m ³)
Transuranic		
Liquid	0	None
Solid	3.5	6
Mixed Transuranic		
Liquid	0	None
Solid	Included in TRU	0.8
Low-Level		
Liquid	0	2
Solid	7,200	55
Mixed Low-Level		
Liquid	4	None
Solid	170	0.8
Hazardous		
Liquid	Included in solid	None
Solid	1,200	0.8
Nonhazardous (Sanitary)		
Liquid	Not reported separately, included in solid	1,550
Solid	52,000	1,500
Nonhazardous (Other)		
Liquid	0	2,990 ^b
Solid	Included in sanitary	0.8 ^c

^a The No Action volumes are from Table 4.2.3.10–1. Incremental waste generation volumes for electrometallurgical treatment facility are from Table E.3.3.6–1. Waste effluent volumes (that is, after treatment and volume reduction) that are used in the narrative description of the impacts are also provided in Table E.3.3.6–1.

^b Includes recyclable wastes.

^c Recyclable wastes.

and the resultant waste effluent used for the waste impact analysis can be found in Section E.3.3.6. A detailed description of the waste management facilities that would be required to support the electrometallurgical treatment facility can also be found in Section E.3.3.6.

Operation of an electrometallurgical treatment facility would impact existing waste management activities at INEL, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during modifications to existing facilities would consist of approximately 2,780 m³ (735,000 gal) of sanitary wastewater, 2,840 m³ (750,000 gal) of other wastewater and 5,730 m³ (7,500 yd³) of solid sanitary wastes. These wastes would have minimal impact and can be easily handled within existing facilities.

The Electrometallurgical Treatment Facility would not generate any high-level waste as a waste stream from processing Pu. However, the Electrometallurgical Treatment Facility would produce an immobilized GBZ product that would require acceptance at a HLW repository. Electrometallurgical treatment for Pu disposition would annually produce an additional 37 m³ (49 yd³) of immobilized GBZ product (LLNL 1996b:7-3). This immobilized GBZ product would require interim storage onsite until acceptance at a HLW repository.

For Pu disposition, approximately 6 m³ (8 yd³) of additional TRU waste consisting of job-control waste (protective clothing and radiological survey waste), HEPA filters, resins, and sludge from liquid TRU treatment would require treatment and repackaging in a radwaste facility to meet the WIPP WAC or alternative treatment level. INEL has existing and planned TRU waste facilities that could be utilized. A small quantity (0.8 m³ [1 yd³]) of mixed TRU solid waste would require treatment and packaging to meet the WIPP WAC or alternative treatment level. Mixed TRU waste would be generated if a TRU waste stream became contaminated with a hazardous waste constituent. To transport the TRU and mixed TRU waste to WIPP (depending on decisions made in the ROD associated with the supplemental EIS for the proposed continued phased development of WIPP for disposal of TRU waste), one additional truck shipment per year or, if applicable, one regular train shipment every other year, or one dedicated train shipment every 8 years, would be required. [Text deleted.]

INEL has existing facilities that could manage the small quantities of LLW. As a result of Pu disposition, approximately 55 m³ (72 yd³) of additional LLW from solidified liquid LLW, protective clothing, and small equipment would require disposal. Using the land usage factor from Section E.1.4, the area required for LLW disposal at INEL would be 0.009 ha/yr (0.02 acres/yr). The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

For Pu disposition, a small quantity (0.8 m³ [1 yd³]) of additional mixed LLW consisting of solvent rags and equipment that have been contaminated with both radioactive and hazardous constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the INEL Site Treatment Plan that was developed to comply with the *Federal Facility Compliance Act*.

Hazardous wastes would consist primarily of analytical solutions and solvent rags. Other hazardous wastes would include paint solvents, various laboratory chemicals, and organic waste from nonradioactive testing. Hazardous wastes would be stored in RCRA-permitted facilities until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

As a result of Pu disposition, approximately 1,550 m³ (410,000 gal) of additional liquid nonhazardous sanitary and 2,990 m³ (790,000 gal) of additional cooling tower blowdown and industrial wastewater would require treatment in accordance with INEL site practice and discharge permits. The 1,500 m³ (2,000 yd³) of additional solid nonhazardous wastes such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practices at INEL.

4.3.5 REACTOR CATEGORY

The following sections describe four reactor alternatives for the disposition of surplus Pu: Existing LWR Alternative, Partially Completed LWR Alternative, Evolutionary LWR Alternative, and the CANDU Reactor Alternative. A common activity for each reactor alternative is the MOX fuel fabrication facility, which is also described. The impacts for each reactor alternative would need to include those shown for the MOX fuel fabrication activity. Depending on the alternative, impacts on the following representative DOE sites may be described: Hanford, NTS, INEL, Pantex, ORR, SRS, and a generic range of site conditions within the United States. The sections describe the construction and operational impacts of the Reactor Alternative facilities on the following potentially affected areas: land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomic, public and occupational health and safety, and waste management. For the CANDU reactor, effects within the United States and Canada are analyzed. Impacts described in these sections are in addition to those associated with the pit disassembly/conversion facility (Section 4.3.1) and the Pu conversion facility (Section 4.3.2).

4.3.5.1 Mixed Oxide Fuel Fabrication Facility

The environmental impacts described in the following sections are based on the analysis of the MOX fuel fabrication facility for the Reactor Category of Alternatives and is described in Section 2.4.5.1. The representative sites used for this facility are: Hanford, NTS, INEL, Pantex, ORR, and SRS. Environmental impacts for a representative commercial facility are also described in the context of a generic range of conditions that could exist at potential locations.

In accordance with the Preferred Alternative for surplus Pu disposition, the MOX fuel fabrication facility could be located at either Hanford, INEL, Pantex, or SRS. As a result of implementing a multiple technology disposition strategy, for analysis purposes, approximately 70 percent of the surplus Pu would be fabricated into MOX fuel. Further tiered NEPA review will be conducted to examine alternative locations, including new and existing facilities, at these four sites should the Preferred Alternative be selected at the ROD.

4.3.5.1.1 Land Resources

The MOX fuel fabrication facility may be located at Hanford, NTS, INEL, Pantex, ORR, SRS, or a commercial MOX fuel fabrication site. At all sites, the MOX fuel fabrication facility would disturb 121 ha (300 acres) of land during construction of which 81 ha (200 acres) would be used during operations. At any of these sites, the MOX fuel fabrication facility would be a stand-alone operation. The facility would be sited in a 1.6-km (1-mi) buffer zone for a total land area of 890 ha (2,200 acres). The buffer zone would be contained within the boundary of all analysis sites except at ORR, where the buffer zone would be less than 1.6 km (1 mi).

Construction and operation of the MOX fuel fabrication facility would not cause indirect land-use impacts at the analysis sites. As discussed in Section 4.3.5.1.8, in-migration of workers would be required at INEL only during the construction phase and at all analysis sites except ORR during the operational phase. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the in-migrating population at each site. Therefore, offsite land use at the representative sites would not be affected.

Hanford Site

Land Use. The potential site for the MOX fuel fabrication facility would utilize vacant land in the 200 Area adjacent to 200 East. Construction of the MOX fuel fabrication facility would be in conformance with existing and future land use as described in the current *Hanford Site Development Plan* and with ongoing discussions in the comprehensive land use planning process. According to the *Hanford Site Development Plan*, 200 Area's land use is identified as waste operations, which includes radioactive material management, processing, and storage (HF DOE 1993c:13,14). [Text deleted.]

Construction and operations would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. The proposal would be consistent with State and local (Benton, Franklin, and Grant Counties and the City of Richland) land-use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with the GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction would be consistent with the industrialized landscape character of the 200 Area and Hanford VRM Class 5 designation of the potential site. A potential visual impact during operation would be from the new stack plumes which could be visible from viewpoints with high sensitivity levels, including State Highways 24 and 240 and the city of Richland; however, because of viewing distance and compatibility of the proposal with existing industrial character, visual impacts would not occur.

Nevada Test Site

Land Use. The potential location for the MOX fuel fabrication facility would be on undeveloped land in Area 6 adjacent to the DAF. Construction and operation of the facility in Area 6 would not be in conformance with the current *Nevada Test Site Development Plan*, which designates the southeast area of NTS as nonnuclear test area. However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as part of the NTS defense program material disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8,3-9; NT DOE 1996e:A-18). [Text deleted.]

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, and controls of adjacent jurisdictions since none of these counties or municipalities currently undertake land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. Views of the proposed action would be blocked from sensitive viewpoints accessible to the public by mountainous terrain.

Idaho National Engineering Laboratory

Land Use. The MOX fuel fabrication facility would be located in or adjacent to the ICPP security area. New construction would be required. Construction and operation of the facility would be in conformance with the current *Idaho National Engineering Laboratory Site Development Plan*, which designates the ICPP as situated within the central core area/Prime Development Land Zone of INEL (IN DOE 1992g:12). [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction would not be in conflict with local land-use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operation would be compatible with the present visual character of INEL, which consists of large industrial facilities and stack plumes. Potential visual impacts could occur from the additional stack plumes; however, the proposal would be consistent with the existing VRM Class 5 industrial landscape character of the ICPP.

Pantex Plant

Land Use. The MOX fuel fabrication facility would be located on undeveloped land in Zone 11. The master plan of the current *Pantex Site Development Plan* designates Zone 11 for applied technology (PX DOE 1995g:16). However, Pantex could revise the site development plan should DOE decide to construct a MOX fuel fabrication facility in Zone 11.

Construction would not affect other site land uses. As discussed in Section 3.5.1, there would be no onsite impacts to prime farmland. The alternative would not be in conflict with the city of Amarillo's land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. [Text deleted.] Potential impacts could occur during operations from the additional stack plumes; however, the visual environment would be consistent with the industrialized landscape character and current VRM Class 5 designation of Zone 11.

Oak Ridge Reservation

Land Use. The MOX fuel fabrication facility would be located on undeveloped land at or adjacent to Y-12. Weapons component manufacturing and development is among the future land uses designated for Y-12 by the future land-use plan of the current *Oak Ridge Reservation Site Development and Facilities Utilization Plan* (OR DOE 1989a:5-6,5-7). However, ORR could revise the site development plan should DOE decide to construct the facility at ORR.

The MOX fuel fabrication facility would not affect other ORR or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with city of Oak Ridge land-use plans, policies, and controls since the *Oak Ridge Area Land Use Plan* designates the potential site for industrial and/or Public use (depending upon the exact location chosen).

Visual Resources. [Text deleted.] Potential visual impacts could occur during operation from the new stack plumes; however, the visual environment would be consistent with the industrialized landscape character and existing VRM Class 5 designation of Y-12.

Savannah River Site

Land Use. The MOX fuel fabrication facility would be located on undeveloped land approximately 1.6 km (1 mi) north of the P-Reactor Area on the east side of SRS Route F. Facility construction and operation would be in conformance with future land use as designated by the current *Savannah River Site Development Plan*. According to the Plan, the future land-use category for the proposed development site is primary industrial mission (SR DOE 1994d:11,12). However, construction of the facility would convert undeveloped, forested land, and a very small portion of NERP lands.

Construction would not affect other SRS or offsite land uses at SRS. There are no prime farmland on SRS. Construction and operation would not be in conflict with the land-use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. [Text deleted.] Construction and operation of the facility would change the current VRM Class 4 designation to Class 5. Potential visual impacts could occur during operation from additional stack plumes. However, because of hilly terrain, impacts to State Highway 125 and SRS Route 1 would not occur.

Generic Site

Land Use. The site chosen for the commercial facility would likely contain adequate land area to accommodate MOX fuel fabrication facility and surrounding undeveloped land area. Construction of the facility could change existing land use. It is anticipated that the facility would be in conformance with site development/facility utilizations plans as well as land use plans, policies, and controls at the Federal, State, and local levels. If site development is not in conformance, it could be possible for land use plans, policies, and controls to be revised. Revisions could include a change in zoning classification of the site. The use of special status lands and prime farmland could be affected.

Visual Resources. It is anticipated that the facility would be relatively visually unobtrusive to adjacent lands due to sensitive site design, earthwork, and landscaping. However, the existing VRM classification could change due to facility construction and operations. It is likely that the existing VRM classification would be Class 4 or 5. Visual impacts to adjacent lands with high sensitivity levels, such as public roads, residential areas, and recreational/scenic areas could be reduced by the 1.6-km (1-mi) buffer zone.

[Text deleted.]

4.3.5.1.2 Site Infrastructure

A MOX fuel fabrication facility is required to support the various reactor alternatives for Pu disposition. The environmental consequences of this MOX fuel fabrication activity is additive to the consequences for each of the reactor alternatives discussed in Sections 4.3.5.2 through 4.3.5.5.

The options considered for the production of MOX fuel include the construction of a facility at a representative site (Hanford, NTS, INEL, Pantex, ORR, or SRS) and the production of MOX fuel assemblies by a commercial nuclear fuel vendor at a generic domestic facility.

Changes to the existing infrastructure at representative sites due to the construction and operation of a facility for the production of MOX fuel are presented in Tables 4.3.5.1.2-1 and 4.3.5.1.2-2, respectively. Construction is estimated to require 6 years to complete.

Table 4.3.5.1.2-1. Additional Site Infrastructure Needed for the Construction of the Mixed Oxide Fuel Fabrication Facility (Annual)

Facility Requirement	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Hanford	833	1	126,180	0	0
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	345,500	58	9,334,800	21,039,531	0
Project usage with facility	346,333	59	9,460,980	21,039,531	0
Amount required in excess of site availability	0	0	0	0	0
NTS					
Site availability	176,844	45	5,716,000	0	0
Projected usage without facility	124,940	25	5,716,000	0	0
Project usage with facility	125,773	26	5,842,180	0	0
Amount required in excess of site availability	0	0	126,180 ^a	0	0
INEL					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage without facility	232,500	42	5,820,000	0	11,340
Project usage with facility	233,333	43	5,946,180	0	11,340
Amount required in excess of site availability	0	0	0	0	0
Pantex					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	46,266	10	795,166	7,200,000	0
Project usage with facility	47,099	11	921,346	7,200,000	0
Amount required in excess of site availability	0	0	0	0	0
ORR					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	726,000	110	379,000	95,000,000	16,300
Project usage with facility	726,833	111	505,180	95,000,000	16,300
Amount required in excess of site availability	0	0	89,180 ^a	0	0

Table 4.3.5.1.2-1. Additional Site Infrastructure Needed for the Construction of the Mixed Oxide Fuel Fabrication Facility (Annual)—Continued

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
SRS					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	794,000	116	28,390,500	0	221,352
Project usage with facility	795,700	119	28,516,680	0	221,352
Amount required in excess of site availability	0	0	126,180 ^a	0	0
Generic Site					
Range of resource availability	49,500-72,000	0.5-10	0-9,130,000	0-102,800,000	0-208,700
Amount required in excess of site availability (lowered)	0	0.5	126,180 ^a	0	0

^a Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: CFFF 1995a:1; GE 1995a:1; HF 1995a:1; INEL 1995a:1; LANL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SPC 1995a:1; SRS 1995a:2.

Table 4.3.5.1.2-2. Additional Site Infrastructure Needed for the Operation of the Mixed Oxide Fuel Fabrication Facility (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement							
	<5	0	13,000	5	20,000	2,350,000	0
Hanford							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	420	204	345,500	58	9,334,800	21,039,531	0
Project usage with facility	425	204	358,500	63	4,354,800	23,389,531	0
Amount required in excess of site availability	<5	0	0	0	0	2,350,000 ^a	0
NTS							
Site availability	1,100 ^b	0	176,844	45	5,716,000	0	0
Projected usage without facility	645	0	124,940	25	5,716,000	0	0
Project usage with facility	650	0	137,940	30	5,736,000	2,350,000	0
Amount required in excess of site availability	0	0	0	0	20,000 ^c	2,350,000 ^a	0
INEL							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage without facility	445	48	232,500	42	5,820,000	0	11,340
Project usage with facility	450	48	245,500	47	5,840,000	2,350,000	11,340
Amount required in excess of site availability	<5	0	0	0	0	2,350,000 ^a	0
Pantex							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	76	27	46,266	10	795,166	7,200,000	0
Project usage with facility	81	27	59,266	15	815,166	9,550,000	0
Amount required in excess of site availability	<5	0	0	0	0	0	0

Table 4.3.5.1.2–2. Additional Site Infrastructure Needed for the Operation of the Mixed Oxide Fuel Fabrication Facility (Annual)—Continued

	Transportation		Electrical		Fuel		
	Roads (km)	Rail (km)	Energy (MWh/yr)	Peak (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
ORR							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	71	27	726,000	110	379,000	95,000,000	16,300
Project usage with facility	76	27	739,000	115	399,000	97,350,000	16,300
Amount required in excess of site availability	<5	0	0	0	0	0	0
SRS							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	230	103	794,000	116	28,390,500	0	221,352
Project usage with facility	235	103	807,000	121	28,410,500	2,350,000	221,352
Amount required in excess of site availability	<5	0	0	0	20,000 ^c	2,350,000 ^a	0
Generic Site							
Range of availability	3-9	0-4.3	49,500-72,000	0.5-10	0-9,130,000	0-102,800,000	0-208,700
Amount required in excess of site availability (lowered)	<2	0	0	4.5	20,000 ^c	2,350,000 ^a	0

^a Facility would be adapted to use fuel oil instead of natural gas.

^b Includes paved and unpaved roads.

^c Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: CFFF 1995a:1; GE 1995 a:1; HF 1995a:1; INEL 1995a:1; LANL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; PX DOE 1995g; SPC 1995a:1; SRS 1995a:2.

Hanford Site

Available reserves would accommodate additional electrical energy and oil requirements for construction of the MOX fuel fabrication facility. Total requirements during construction would be within site availability. Impacts during operation would be greatest for natural gas which would require a 2,350,000 m³/yr (82,990,250 ft³/yr) increase over availability. This natural gas could be procured through normal contractual means. Total requirements for electrical energy, peak load, and oil would be less than that already available at the site.

Nevada Test Site

Available reserves would accommodate additional electrical energy and oil requirements for construction of the MOX fuel fabrication facility. Total electrical energy required at NTS during the 6-year construction period would be less than site availability, and total oil requirements would be above site availability. Additional oil required could be procured through normal contractual means. Impacts during operation would be greatest for natural gas which is not currently used at NTS; however, oil-based utilities could be used to meet the need in lieu of natural gas. Peak electrical power load would be higher than projected usage without the facility but under current site availability. Projected total electrical energy usage with the facility would be more than projected usage without the facility, but would be less than site availability. Oil consumption would increase slightly above site availability and would be procured through normal contractual means.

Idaho National Engineering Laboratory

Available reserves would accommodate additional electrical energy and oil requirements for construction of the MOX fuel fabrication facility. Impacts during operation would be greatest for natural gas which is not currently

used at INEL; however, oil based utilities could be modified to meet the need. Total requirement for electrical energy would be within site availability, and the total requirement for oil would be within current site availability.

Pantex Plant

Available reserves would accommodate additional electrical energy and oil requirements for construction of the MOX fuel fabrication facility. Total requirement for both electrical energy and oil would be less than current site availability. Requirements during operation for natural gas would be more than projected usage without the facility but less than site availability. The total electrical energy requirement and the total oil requirement would be less than current availability. Adequate electrical energy is available from the regional power grid.

Oak Ridge Reservation

Available reserves would accommodate the additional electrical energy requirement for construction of the MOX fuel fabrication facility. The requirement for oil would be more than current site availability but could be procured through normal contractual means. Site infrastructure impacts during operation would be minor compared with available resources. Onsite access to the MOX facilities would require less than 5 km (3 mi) of new roadway. Peak electrical power load would be greater than projected peak load without the facility, but would be less than current availability. The total requirement for oil with the MOX fuel fabrication facility would be slightly less than site availability. The total requirement for natural gas would be well within site availability.

Savannah River Site

Available reserves would accommodate additional electrical energy and oil requirements for construction of the MOX fuel fabrication facility. Total requirement for oil would be slightly higher than site availability but could be procured through normal contractual means. Impacts during operation would be greatest for natural gas which is not currently used at SRS; however, fuel oil based utilities could be modified to meet the need. Peak electrical power load would be slightly greater than projected peak load without the facility, but well under availability. The total requirement for electrical energy with the facility would be well under site availability, and the total requirement for oil would be slightly above site availability but would be handled as stated above.

Generic Site

Since no domestic site exists for the fabrication of MOX fuel, the site infrastructure impact analysis for construction and operation of the facility compares the requirements shown in the appendices with the generic fuel fabrication facility site described in Section 3.10.2. It is possible that construction requirements for peak electric load and oil would exceed availability for an actual domestic site at the low-end range of available resources. Site infrastructure resources required for operation of a MOX fuel fabrication facility would exceed availability of peak electric load, oil, and natural gas at the low-end range of available resources at a generic domestic site. These additional resource requirements could require new electrical transmission lines, oil storage tanks, and gas transfer pipelines. The generic regional power pool (Table 3.10.2-2) shows that there is sufficient reserve capacity to support the additional load. Oil could be obtained from existing commercial sources. Natural gas may not be available, but oil-based utilities could substitute.

4.3.5.1.3 Air Quality and Noise

Construction and operation of the MOX fuel fabrication facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.5.1.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts for this facility are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM₁₀ and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction.

The MOX fuel fabrication process involves pure Pu materials that would require minimal chemical processing. The emissions estimates for the facility are based on operational experience at European MOX facilities, the glovebox ventilation system design, and the actual process. Feed material preparation and fabrication of fuel pellets would be done in gloveboxes to control contamination for normal operations. The ventilation system for the MOX fuel fabrication facility would be used specifically for contamination control and would use a large volume of air to assure contamination control. There would be essentially four stages of HEPA filters on the glovebox exhaust that would eliminate (or reduce below detection limits) a minimum of 99.95 percent of nonradioactive particulates. Radioactive particulate emissions are discussed in Section 4.3.5.1.9. The glovebox exhaust would be mixed with room air exhaust, which also has two stages of HEPA filters for further filtration before release to the environment. The use of HEPA filters would not reduce VOC emissions because VOCs are not in a particulate form. There would also be process-specific scrubbers, vacuum traps, and filters that reduce the chance of criteria or toxic/hazardous pollutant releases from occurring. Because of the processing technology (which does not create some of the criteria pollutants), the defense-in-depth for Pu processing systems, and the extensive HEPA filtration (which removes the remaining criteria pollutants), emissions for criteria pollutants other than VOCs are expected to be below detection limits. VOC emissions of 1,000 kg/yr (2,200 lbs/yr), are shown in Table F.1.3–6, and would give trace concentrations at the site boundaries.

NOISE

The location of the facilities associated with the MOX fuel fabrication facility relative to the site boundary and sensitive receptors was examined for each of the seven sites to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Nontraffic noise sources associated with operation of a MOX fuel fabrication facility include ventilation systems, cooling systems, and diesel generators. These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the analyzed sites, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.5.1.4 Water Resources

The construction and operation of a MOX fuel fabrication facility would affect water resources. Water resource requirements and discharges provided in Tables C.1.1.2–3 and C.2.1.2–3 and Table E.3.2.3–1, were used to assess impacts to surface and groundwater. The discussion of impacts is provided for each site separately. Table 4.3.5.1.4–1 presents No Action surface and groundwater uses and discharges at each site, and the potential changes resulting from construction and operation of a MOX fuel fabrication facility.

Hanford Site

Surface Water. Surface water from the Columbia River would be used as the water source for construction and operation of the MOX fuel fabrication facility. During construction, the quantity of water required would be approximately 1.9 million l/yr (0.5 million gal/yr), which would represent a 0.01-percent increase over the projected annual surface water withdrawal. During operation, the total annual water requirement for the facility would be approximately 56.8 million l/yr (15 million gal/yr), which would represent a 0.4-percent increase over the existing surface water withdrawal and approximately 0.00005 percent of the annual average flow rate of the Columbia River (3,360 m³/s [118,642 ft³/s]). These additional withdrawals would have minimal effects on surface water availability.

[Text deleted.]

During construction of the MOX fuel fabrication facility, sanitary and other nonhazardous wastewater (1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to an existing wastewater treatment system. During operation, approximately 43.5 million l/yr (11.5 million gal/yr) of sanitary and other wastewater would be discharged to this wastewater treatment system. This would represent a 17.7-percent increase in the wastewater discharged annually at Hanford. All discharges would be monitored to comply with discharge requirements. Negligible impacts are expected.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be collected, monitored for radioactivity, and, if uncontaminated, discharged to evaporation/infiltration ponds or to local drainage channels. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity and, if uncontaminated, discharged to evaporation/infiltration ponds or to local drainage channels.

The MOX fuel fabrication facility would be located outside of the Columbia River floodplain and the area of the probable maximum flood. The maximum probable flood is greater than the 500-year flood.

Groundwater. No groundwater would be used during construction or operation of the MOX fuel fabrication facility; therefore, there would be no impacts to groundwater availability. No wastewater would be discharged directly to groundwater; therefore, groundwater quality should not be affected. Treated wastewater discharged to evaporation/infiltration ponds that does not evaporate, however, would percolate downward toward the groundwater. This wastewater would be monitored and would not be discharged until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Table 4.3.5.1.4-1. Potential Changes to Water Resources Resulting From the Mixed Oxide Fuel Fabrication Facility

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS	Generic
Water Source	Surface	Ground	Ground	Ground	Surface	Ground	Ground
No Action water requirements (million l/yr)	13,511	2,400	7,570	249	14,760	13,247	0
No Action wastewater discharge (million l/yr)	246	82	540	141	2,277	700	0
Construction							
Water Availability and Use							
Total water requirement (million l/yr)	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Percent increase in projected water use ^a	0.01	0.08	0.03	0.8	0.01	0.01	NA
Water Quality							
Total wastewater discharge (million l/yr)	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Percent change in wastewater discharge ^b	0.8	2.3	0.4	1.3	0.08	0.3	NA
Percent change in streamflow	neg	NA	NA	NA	0.004 ^c	0.04 ^d	NA
Operation							
Water Availability and Use							
Total water requirement (million l/yr)	56.8	56.8	56.8	56.8	56.8	56.8	56.8
Percent increase in projected water use ^e	0.4	2.4	0.8	5.1	0.4	0.4	NA
Water Quality							
Total wastewater discharge (million l/yr)	43.5	43.5	43.5	43.5	43.5	43.5	43.5
Percent change in wastewater discharge ^f	17.7	53	8.1	30.9	1.9	6.2	NA
Percent change in streamflow	neg	NA	NA	NA	0.02 ^c	0.9 ^d	NA

Table 4.3.5.1.4-1. Potential Changes to Water Resources Resulting From the Mixed Oxide Fuel Fabrication Facility—Continued

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS	Generic
Floodplain							
Is actions in 100-year floodplain?	No	No	No	No	No	No	No
Is critical action in 500-year floodplain?	No	Uncertain	Uncertain	No	No	Uncertain	Uncertain
^a Percent increases in water requirements during construction MOX fuel fabrication facility are calculated by dividing water requirements for the facility (1.9 million l/yr) with that for No Action water requirements each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), SRS (13,247 million l/yr), and generic site (0 million l/yr). ^b Percent changes in wastewater discharged during construction for the MOX fuel fabrication facility are calculated by dividing wastewater discharges for the facility (1.9 million l/yr) with that for No Action discharges at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), SRS (700 million l/yr), and generic site (0 million l/yr). ^c Percent changes in stream flow from wastewater discharges are calculated from the average flow of Clinch River (132 m³/s) and East Fork Poplar Creek (1.5 m³/s). The comparison for the East Fork Poplar Creek is shown in the table. ^d Percent changes in stream flow from wastewater discharge are calculated from the minimum flow of the Fourmile Branch (0.16 m³/s). ^e Percent increases in water requirements during operation of the MOX fuel fabrication facility are calculated by dividing water requirements for the Facility (56.8 million l/yr) with that for No Action water requirements at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), SRS (13,247 million l/yr), and generic site (0 million l/yr). ^f Percent changes in wastewater discharged during operation of the MOX fuel fabrication facility are calculated by dividing wastewater discharges for the facility (43.5 million l/yr) with that for No Action discharges at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), SRS (700 million l/yr), and generic site (0 million l/yr).							

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1991a:1; INEL 1995a:1; LANL 1996d; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Nevada Test Site

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with any of the proposed facilities; groundwater would be used as the water source for the MOX fuel fabrication facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the MOX fuel fabrication facility, sanitary wastewater (1.9 million l/yr [0.5 million gal/yr]) would be generated. During operation, a maximum of approximately 43.5 million l/yr (11.5 million gal/yr) of sanitary and other wastewater would be discharged to a new wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycle.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity and, if uncontaminated, recycled or discharged to natural drainage channels. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity and, if uncontaminated, discharged to natural drainage channels or be available to recycle.

No studies have been conducted to assess the 500-year floodplain boundaries at NTS. An assessment of the 500-year floodplain at NTS could be developed in future environmental studies. Studies of the 100-year floodplain have shown it to be confined to the Jackass Flats and Frenchman Lake areas. The proposed site for the MOX fuel fabrication facility is not located in either of these areas. However, since the NTS is in a region where most flooding occurs from locally intense thunderstorms that can create brief (less than 6 hours) flash floods, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater. Annual construction water requirements for the facilities (1.9 million l/yr [0.5 million gal/yr]) represent approximately 0.005 percent of the minimum estimated annual recharge (38 billion l/yr [10 billion gal/yr]) to the regional aquifer under NTS. As shown in Table 4.3.5.1.4–1, the quantity of water required for construction of the facility would represent approximately a 0.08-percent increase over the projected No Action groundwater usage. Withdrawal of this additional quantity should not impact groundwater availability. Operating the facility at NTS would require 56.8 million l/yr (15 million gal/yr), which is approximately 2.4 percent of the projected No Action groundwater usage. This additional withdrawal represents less than 0.2 percent of the estimated annual recharge. Minimal impacts to groundwater availability are expected.

Construction and operation of a MOX fuel fabrication facility would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward into the groundwater of the Valley-Fill Aquifer. This water would be monitored prior to discharge and would not be discharged until contaminant levels were within the limits specified in the State of Nevada permit. Impacts to groundwater quality are, therefore, not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for a MOX fuel fabrication facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of a MOX fuel fabrication facility, sanitary wastewater (1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to the existing wastewater treatment system at the ICPP Area. This amount would represent a 0.4-percent increase in the effluent discharged at INEL. During operation, a maximum of approximately 43.5 million l/yr (11.5 million gal/yr) of sanitary and other wastewater would be discharged to this wastewater treatment system. This amount represents a 8.1-percent increase in INEL's annual effluent. After treatment, all wastewater generated during construction and operation would be available to recycle or would then be allowed to evaporate to the atmosphere, and/or infiltrate to the subsurface. All discharges would be monitored to comply with discharge requirements.

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity and, if uncontaminated, discharged to infiltration/evaporation ponds or to local drainage channels. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity and, if uncontaminated, discharged to local drainage channels or evaporation/infiltration ponds.

The potential location for a MOX fuel fabrication facility is not located in an area historically prone to flooding, but is within the flood zone that could occur as a result of the failure of the MacKay Dam during a maximum probable flood. This flood event would be more critical than either the 100- or 500-year flood. Because INEL is in a region where flash floods could occur, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. As shown in Table 4.3.5.1.4-1, construction and operation water requirements for the facility (1.9 million l/yr [0.5 million gal/yr]), and 56.8 million l/yr (15 million gal/yr), respectively, would represent 0.03- and 0.8-percent increases over the projected annual groundwater usage. These withdrawals would increase the total projected amount to be pumped at INEL to 17.6 percent of the total allotment during construction and 17.7 percent of the allotment during operation. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73). These additional withdrawals would not impact groundwater availability.

Construction and operation of a MOX fuel fabrication facility would not result in direct discharges to groundwater. Treated wastewater that is discharged to disposal ponds but does not evaporate, however, could percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified. Impacts to groundwater quality are, therefore, not expected. In addition, other factors contributing to a lessening of potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Pantex Plant

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the MOX fuel fabrication facility. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of a MOX fuel fabrication facility, sanitary wastewater (1.9 million l/yr [0.5 million gal]) would be generated and discharged to the existing wastewater treatment systems north of Zone 12. During operation, a maximum of approximately 43.5 million l/yr (11.5 million gal/yr) of sanitary wastewater and other wastewater would be discharged to either of these wastewater treatment systems. After treatment, all wastewater generated during construction and operation would be discharged to the playa lakes or would be available for

recycle. In 1994, Pantex averaged approximately 1.4 million l/day (370,000 gal/day) of wastewater discharged to the playas. This quantity is expected to decrease in the future. The expected quantity of additional wastewater potentially discharged to the playas during operation (0.12 million l/day [31,704 gal/day]) should not cumulatively cause any exceedances of the monthly average limit of 2.46 million l/day (0.65 million gal/day).

Water from heating the facility would be recycled to the heating unit. Steam plant blowdown would be discharged through the sanitary wastewater system. Steam condensate from heating, condensation from air conditioning, and other distillates would be monitored for radioactivity and, if uncontaminated, discharged to local drainage channels or the playas. Fire sprinkler water and truck hosedown water would be collected, monitored, sampled, and treated as process wastewater, when required. It would be monitored for radioactivity and, if uncontaminated, available for recycle or discharged to local drainage channels or the playas.

The potential site for the MOX fuel fabrication facility would be located in Zone 11. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in Zone 11, there would be no impacts to floodplains. However, flooding in other areas of Pantex could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. All water required for construction and operation would be supplied from groundwater using the existing supply system which obtains water from the Ogallala aquifer or possibly from the Hollywood Road Wastewater Treatment Plant. Construction water requirements for a MOX fuel fabrication facility would be small relative to the recoverable water in aquifer storage which for the year 2010 was estimated to be 287 trillion l (76 trillion gal) (PX WDB 1993a:1). As shown in Table 4.3.5.1.4-1, construction of the facility would require 1.9 million l/yr (0.5 million gal/yr) of water, which represents approximately a 0.8-percent increase over Pantex's projected annual groundwater usage and would be approximately 0.1 percent of the capacity of the groundwater system (1,900 million l/yr [502 million gal/yr]). Water required for operations would increase projected water requirements for Pantex by 5.1 percent. Previous studies have shown that, when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala aquifer, an average of 1.8-m/yr (5.9-ft/yr) decline in the water table occurred over a 10-year period in the local well field area. This water level decline caused a shift in the groundwater flow direction beneath Pantex. Operating the facility at Pantex would require 56.8 million l/yr (15 million gal/yr), resulting in a small drawdown representing approximately 2.9 percent of the available groundwater. Although this additional groundwater withdrawal would add to the existing decline in water levels of the Ogallala Aquifer, the estimated degree is not substantial. The total groundwater withdrawal including this facility would be 305 million l/yr (80.9 million gal/yr) which, because of expected cutbacks in other programs, would be 63 percent less than what is currently being withdrawn (836 million l/yr [221 million gal/yr]) from wells at Pantex.

Construction and operation of a MOX fuel fabrication facility would not result in direct discharges to groundwater. Treated wastewater discharged to playas, however, could percolate downward into the groundwater of the near surface aquifer. This water would be monitored and would not be discharged until contaminant levels were within the limits specified by the TNRCC. [Text deleted.]

Although the expected drawdowns caused by withdrawing the water required for this alternative are small, the overall decline in groundwater levels in the Amarillo area is of concern. Possible groundwater conservation measures at Pantex that could be considered including decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Oak Ridge Reservation

Surface Water. Water required for construction and operational of a MOX fuel fabrication facility would be provided via existing distribution systems. The source of this water is the Clinch River and its tributaries. During construction, the quantity of water required would be approximately 1.9 million l/yr (0.5 million gal/yr), which would represent a 0.01-percent increase over the projected no action annual surface water withdrawal. During operation, water requirements would be approximately 56.8 million l (15 million gal) annually. This represents a 0.4-percent increase in the projected annual surface water withdrawal for ORR. These additional water withdrawals from the Clinch River should cause minimal impacts to surface water availability.

During construction of the MOX fuel fabrication facility, sanitary wastewater (approximately 1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to the existing wastewater treatment system in the Y-12 area. This would cause a less than 1-percent increase in the effluent from the Y-12 area. During operation, a total of 43.5 million l/yr (11.5 million gal/yr) of wastewater would be generated by the facility. This would cause a 1.9-percent increase in the effluent discharged from the Y-12 area. All discharges would be monitored to comply with discharge requirements. No impacts would be expected. Fire sprinkler water and truck hosedown water would be collected in tanks, monitored for radioactivity, and then transferred by pipeline or tanker to treatment facilities as required. Uncontaminated water would be pumped to storm drains.

Since the MOX fuel fabrication facility would be located outside both the 500- and 100-year floodplains no impact to floodplains is expected.

Groundwater. No groundwater would be used for any project-related water requirements and no wastewater would be discharged directly to groundwater; therefore, neither groundwater quality nor availability would be affected.

Savannah River Site

Surface Water. No surface water withdrawals would be made; groundwater would be used for construction and operation of a MOX fuel fabrication facility. During construction of a MOX fuel fabrication facility, sanitary wastewater (approximately 1.9 million l/yr [0.5 million gal/yr]) would be generated and discharged to the sitewide wastewater treatment system, which would not require any modification. This amount would represent a 0.3-percent increase in the estimated annual flow to this system and could be handled within the existing capacity. During operation, a total of 43.5 million l/yr (11.5 million gal/yr) of wastewater would be generated by the facility, representing a 6.2-percent increase for SRS. This additional quantity would represent approximately 0.9 percent of the Fourmile Branch's minimum flow. [Text deleted.]

Cooling system blowdown is another non-hazardous wastewater stream generated by this facility. The facility would release approximately 0.04 million l (11,200 gal) of treated blowdown water over an 8-hour period, 250 days/yr. All discharges to surface waters would be monitored to comply with discharge requirements.

Fire sprinkler water and truck hosedown water would be collected in tanks, monitored for radioactivity, and then transferred by pipeline or tanker to treatment facilities as required. Uncontaminated water would be pumped to storm drains.

The potential location of a MOX fuel fabrication facility would be located outside the 100-year floodplain. Information on the location of the 500-year floodplain boundary could be developed in future environmental studies.

Groundwater. During construction, the quantity of water required would be approximately 1.9 million l/yr (0.5 million gal/yr), which would represent a 0.01-percent increase over the existing projected annual groundwater withdrawal. During operation, water requirements would be approximately 56.8 million l/yr

(15 million gal/yr) and would represent a 0.4-percent increase in groundwater withdrawals. Minimal impacts to groundwater availability are expected. No wastewater would be discharged directly to groundwater; therefore, groundwater quality should not be affected.

Generic Site

Utilizing an existing fuel fabrication facility should not cause any impacts to water resources outside of those identified in the site-specific environmental impact statements which have been prepared for these facilities. There would be no noticeable changes to current use of water resources. The facilities would continue to obtain raw water from either surface or groundwater sources which have an adequate supply to support them. Wastewater would continue to be treated, monitored, and discharged under permit requirements.

[Text deleted.]

4.3.5.1.5 *Geology and Soils*

This section discusses the environmental impacts to the geologic and soil resource as related to the construction and operation of the MOX fuel fabrication facility proposed for the Hanford, INEL, Pantex, SRS, NTS, ORR, and at an existing commercial uranium fuel fabrication facility, generic environment. A MOX fuel fabrication facility, at any of the representative sites, will involve some ground-disturbing construction activities (121 ha [300 acres]) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. Specifically, the relative annual amount of precipitation is greater at many eastern areas relative to most western areas. Specifically, ORR and SRS receive a greater relative amount of precipitation than Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe.

No apparent direct or indirect effects on geologic resources are anticipated. Neither facility construction and operational activities or site infrastructure improvements will restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is relatively low for many western areas, including Pantex, Hanford, INEL, and NTS. The soil erosion potential for many eastern areas including ORR and SRS during construction and operational activities is moderate due primarily to greater relative annual precipitation. The generic MOX fabrication facility could be located in either a low precipitation area or an area with a greater relative annual precipitation. Soil disturbance would occur primarily from ground-disturbing construction activities (foundation preparation) and associated building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on the frequency and severity of rain, wind velocities (increased wind velocities and durations increase potential soil erosion), and the size, location, and duration of ground-breaking activities with respect to local drainage and wind patterns.

Operational effects to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvement (buildings, roads, and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal.

[Text deleted.]

4.3.5.1.6 *Biological Resources*

Construction of the MOX fuel fabrication facility would require 121 ha (300 acres) of land at each of the DOE sites analyzed and at the generic site. This includes areas on which plant facilities would be constructed, as well as areas used for construction laydown. Consultation with USFWS and State agencies would be conducted at the site-specific level, as appropriate to avoid potential impacts to threatened and endangered species, and other protected species and habitat.

Hanford Site

For analytical purposes it is assumed that the MOX facility would be located west of the 200 East Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the MOX facility would result in the disturbance of terrestrial habitat equaling about 0.08 percent of Hanford. This includes areas on which plant facilities would be constructed as well as areas revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. The facility location falls within the sagebrush/cheatgrass or Sandberg's bluegrass community. Sagebrush communities are well represented on Hanford, but they are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture. Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants.

Construction of the MOX facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the MOX facility. These disturbance may cause some species to move from the area. Disturbances to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the MOX facility would not affect wetlands since no wetlands exist near the assumed facility location. Groundwater would be used and wastewater would be discharged to evaporation/infiltration ponds; therefore, wetlands would not be affected.

Aquatic Resources. Construction of a MOX facility at Hanford would not impact aquatic resources since there are no surface water bodies sufficiently near the assumed facility location that would be directly affected by construction activities or indirectly affected by runoff. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure so impacts to aquatic resources from impingement and entrainment would be minimal. Since the volume of water included represents a small percentage of the flow of the river, flow-related impacts to aquatic resources would be minimal. Wastewater would be discharge to evaporation/infiltration ponds; therefore, aquatic resources would not be affected.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species would likely be affected by construction and operation of the MOX facility; however, sagebrush habitat would be disturbed. The sagebrush community is important nesting/breeding and foraging habitat for several State-

listed and candidate species such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, sage sparrow, and sage thrasher. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of plant species or animal species in the area to be disturbed.

Nevada Test Site

It is assumed that the MOX facility would be located in the Frenchman Flat area of the NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened species are discussed below.

Terrestrial Resources. Construction and operation of the MOX facility at NTS would result in the disturbance of terrestrial resources equaling about 0.03 percent of NTS. This includes areas on which facilities would be constructed, as well as areas used for construction laydown. Vegetative cover within the assumed project area, which is primarily creosote bush (Figure 3.3.6–1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the MOX facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise could cause larger mammals and birds in construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the proposed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the MOX facility would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the MOX facility would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location.

Threatened and Endangered Species. The desert tortoise is a federally listed threatened species that could be affected by construction of the MOX facility at NTS. Construction activities such as land-clearing operations, trenches, and excavation could pose a threat to the tortoise. Measures from previous projects at NTS designed to avoid impacts to the desert tortoise have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training, putting restrictions on vehicle speeds and off-road movement, conducting clearance surveys prior to surface disturbance, approving stop work authority if tortoises are found within work areas, removing tortoises from roadways and work areas, placing permanent and temporary tortoise proof fencing around trenches, landfills, and treatment ponds, inspecting trenches, and having biologists survey when heavy equipment is in use. The USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the MOX facility.

[Text deleted.]

Any listed plant species (Table 3.3.6–1) located within the construction area would be lost during land clearing activities. Preactivity surveys would be required prior to construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicle traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on the NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the MOX facility (Section 4.3.5.1.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that the MOX fuel fabrication facility would be located adjacent to the ICPP. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the MOX fuel fabrication facility would result in the disturbance of terrestrial habitat equaling about 0.05 percent of INEL. This includes areas on which plant facilities would be constructed, as well as areas revegetated following construction. Vegetation within the assumed site would be destroyed during land clearing operations. Big sagebrush is the dominant plant within the site. Plant communities in which big sagebrush is the dominant overstory species are well represented on INEL, but are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture.

Construction of the MOX fuel fabrication facility would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would be lost during land-clearing activities. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they move was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. The closest pronghorn wintering area is located 4.8 km (3 mi) from the assumed site, therefore, wintering pronghorn should not be affected (IN DOE 1978a:222). Nests and young animals living within the project area could be lost during construction. The assumed site would be surveyed as necessary for the nests of migratory birds before construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the MOX fuel fabrication facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Construction and operation of the MOX fuel fabrication facility would not affect wetlands since there are no wetlands on the assumed site. Wetlands associated with the Big Lost River are located about 1.6 km (1 mi) from the facility location; therefore, impacts to these wetlands are not expected.

Aquatic Resources. Construction and operation of the MOX fuel fabrication facility would not impact aquatic resources since there are no surface water bodies on the assumed site. The nearest surface water body is in the Big Lost River which is located 1.6 km (1 mi) from the facility location.

Threatened and Endangered Species. It is unlikely that federally listed threatened or endangered species would be affected by construction of the MOX fuel fabrication facility on INEL, but several State-listed status species may be affected. [Text deleted.] Burrows and foraging habitat for the pygmy rabbit would be lost. Bat

species such as the Townsend's western big-eared bat may roost in caves and forage throughout the assumed site. One State-listed sensitive plant species could potentially be affected by construction of the facility. The plant species, tree-like oxytheca, has been collected at eight sites on INEL and at only two other sites in Idaho. If present, individual plants of this species could be destroyed during land clearing activities. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrence of these species in the area to be disturbed. No impacts to threatened and endangered species are expected due to facility operation.

Pantex Plant

It is assumed that the MOX facility would be located within Zone 11, which is a developed area that lacks natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the assumed facility location; however, small mammals and some birds and reptiles could be displaced by construction. Since the area does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the MOX facility. During operation, wastewater would be discharged to a site playa through an NPDES-regulated outfall. The additional water could lead to a minor increase in open water near the outfall, as well as a change in plant species composition. It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of the MOX facility. Although the site has already been disturbed, it is possible that the State-listed Texas horned lizard could still be present. Preactivity surveys would be conducted as appropriate prior to construction.

Oak Ridge Reservation

It is assumed that the MOX fabrication facility would be located adjacent to the Y-12 Area of ORR. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the MOX facility at ORR would result in the disturbance of terrestrial habitat equaling about 0.9 percent of ORR. This acreage includes areas on which the facility would be constructed, as well as areas used for constructing laydown. Vegetation within the area to be developed would be destroyed during land clearing. The area immediately adjacent to Y-12 is largely grassland or disturbed land; it is in turn bordered by oak-hickory forest or pine and pine-hardwood forest (Figure 3.6.6-1). While grassland and disturbed land would be affected most by construction, both forest types could also be impacted. None of the community types that could be disturbed are considered rare within the region.

Construction of the proposed facility would affect animal populations. Less mobile animals with the proposed project area, such as amphibians, reptiles, and smaller mammals, would be lost during land-clearing activities. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site could be lost during construction. The site would be surveyed as necessary for the nests of migratory birds before construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the proposed facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Because the majority of the area in which the proposed facility would be located is upland, it is expected that direct impacts to wetlands could be avoided. Implementation of erosion and sediments control

measures would control secondary impacts. Since existing intake and discharge structures would be used during both construction and operation, it would not be necessary to disturb wetlands along the Clinch River or East Fork Poplar Creek. Any unavoidable impact to wetlands would be mitigated according to DOE policy set forth in 10 CFR 1022 and in accordance with the requirements of a COE permit.

During construction and operation, discharges would be directed to East Fork Poplar Creek. Discharges would have a minimal impacts on the flow of the stream and are not expected to affect associated wetlands. All wastewater discharges would be treated as necessary to meet NPDES permit requirements.

Aquatic Resources. Construction and operation of the MOX facility could cause water quality changes (primarily sediments leading and resulting turbidity) to Bear Creek or East Fork Poplar Creek as a result of soil erosion. Soil erosion and sediment control measures would be implemented to control erosion. Water requirements during both construction and operation would be met by existing site sources. Since existing intake and discharge structures would be used, direct disturbance to aquatic resources in the Clinch River would not occur. Water withdrawal during construction and operation would represent a very small percentage of the Clinch River's average flow and would have little affect on the flow of the river. Increases in impingement and entrainment impacts would, therefore, be minimal and would be unlikely to affect fish populations in the river.

During construction and operation, wastewater would be discharge to West Fork Poplar Creek. The small volume of wastewater discharged to the stream would be expected to have negligible impacts on aquatic resources during either construction or operation. In addition, NPDES-permit requirements would be met.

Threatened and Endangered Species. It is unlikely that federally listed threatened and endangered species are expected to be affected by construction of the MOX facility. The Tennessee dace is sensitive to sedimentation and actively seeks clean gravel for spawning. An increase in amount or duration of sediment runoff to Bear Creek during facility construction could impact this fish species. Preactivity surveys would be conducted as appropriate before construction to determine the occurrence of special status species in the area to be disturbed. No additional impacts are expected during operation of the facility.

Savannah River Site

It is assumed that the MOX fuel fabrication facility would be located about 1.6 km (1 mi) north of the P-Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the MOX facility would result in the disturbance of terrestrial habitat equaling about 0.15 percent of SRS. Vegetation within the assumed facility location, which would be lost during land-clearing activities, consists of loblolly, longleaf, and slash pine. This community type is common on SRS and throughout the region.

Construction of the MOX facility would affect animal populations. Less mobile animals within the project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site will be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most types of wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Since the majority of the assumed site is upland, the facility could be located to avoid direct impacts to wetlands. Implementation of soil erosion and sediment control measures would control secondary impacts. Due to the relatively small amount of water required during both construction and operation, existing intake and discharge structures would be used. It would not be necessary to disturb wetlands along site streams. Any unavoidable impacts to wetlands would be mitigated. Wastewater discharge from construction and operation would be minimal and would not be expected to affect wetlands associated with the receiving stream. All wastewater discharges would be treated as necessary to comply with NPDES-permit requirements.

Aquatic Resources. Stormwater runoff during construction of a MOX fuel fabrication facility at SRS could cause temporary water quality changes in local tributaries to Par Pond. Water requirements during construction would be met by existing site sources. Since new intake and discharge structures would not be required, direct disturbance to aquatic resources in site water bodies would not occur. Wastewater discharges during construction would be minimal and would not be expected to affect aquatic resources.

Operation of the MOX fuel fabrication facility would necessitate water withdrawal from the Savannah River. Water would be withdrawn through existing intake structures. The small volume of water required would not affect the river's flow (Section 4.3.5.1.4), nor increase the entrainment and impingement of fish; thus, fish populations should not be affected. In compliance with the *Anadromous Fish Conservation Act* (16 USC 757a), populations of anadromous fish species on or near SRS would be sustained and their movement unobstructed by project construction and operation. During operation, nonhazardous wastewater would be discharged to local drainage channels. Flow increases are not expected to impact stream hydrology or aquatic resources. All discharges would be required to meet NPDES-permit requirements.

Threatened and Endangered Species. It is unlikely that federally listed threatened or endangered species are expected to be affected by construction or operation of a MOX fuel fabrication facility. Although bald eagles have been sighted in the vicinity of the assumed facility location, it is unlikely that construction and operation of the MOX fuel fabrication facility would affect this species. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the site that this species would not be directly affected by the MOX facility. Preactivity surveys would be conducted as appropriate before construction to determine the presence of any special status species on the proposed site.

Generic Site

For analytical purposes it is assumed that a MOX fuel fabrication facility could be located at an unspecified location within the deciduous forest, southeast evergreen forest, or grassland principal vegetation type. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of a MOX fuel fabrication facility would result in the direct disturbance of terrestrial resources. Surrounding areas could be indirectly affected by erosion and sedimentation. Construction of the facility would affect animal populations. Specific impacts would vary with the particular site chosen; however, certain general types of impacts could be expected regardless of location. Less mobile animals within the project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed facility location may not survive. The

location will be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most types of wildlife because they would be maintained as landscaped areas.

Disturbances associated with both construction and operation, such as noise and human presence, could affect wildlife living adjacent to the facility. These disturbances could cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

It is not possible to identify the particular vegetative communities to be disturbed since the location of the facility is not known; however, development could take place within the deciduous forest, southeast evergreen forest, or grassland principal vegetation type (Section 3.11.6). Due to previous disturbance, vegetation found at a particular location could vary considerably from that which may have once occurred. In fact, the presence of natural climax communities in certain areas could be considered uncommon and, thus, sensitive to development. For example, little native grassland exists due to the extensive conversion of this community to agriculture use. Tiered NEPA documentation will address site-specific impacts.

Wetlands. Wetlands could be affected either directly or indirectly by construction of a MOX fuel fabrication facility. Clearing and grading operations could result in the direct loss of wetlands, although proper placement of the facility within the overall site would eliminate or reduce the potential for such loss. Where direct impact is unavoidable, mitigation measures would be developed consistent with 10 CFR 1022 and in accordance with the conditions of a COE permit, if applicable. This would limit the disturbance to the smallest possible area, and mitigation measures would offset wetland loss.

Indirect impacts to wetlands from a MOX fuel fabrication facility could occur as a result of stormwater runoff carrying sediments to wetlands adjacent to disturbed areas. Changes in hydrology and soils could occur as a result of alterations in water levels and the buildup of sediments. These changes could, in turn, change the vegetative composition of the wetland.

The potential to affect wetlands would depend on where the facility was located. Although wetlands occur in each of the principal vegetation types within which a MOX fuel fabrication facility could be located, they are most prevalent in the southeastern evergreen forest, southwestern and northwestern portions of the deciduous forest, and the northern portion of grassland community regions of the site area. Thus, if the commercial MOX fuel fabrication facility were constructed in one of these areas, there would be a greater potential to impact wetlands. However, even within these regions, wetlands could be largely avoided during the siting process. Site-specific impacts will be addressed in tiered NEPA documentation.

Aquatic Resources. During construction of a MOX fuel fabrication facility, potential impacts to aquatic resources could result from stormwater runoff. Runoff could alter flow rates, increase turbidity, and result in sedimentation of stream beds. These impacts could, in turn, cause temporary and permanent changes in species composition and density, and could alter breeding habitats. Operational impacts to aquatic resources would be expected to be minimal since wastewater volumes would be minimal and would be discharged through an NPDES-permitted outfall. As discussed in Section 3.11.6, a wide variety of aquatic resources occur within the principal vegetation types within which this facility could be located. Since a site has not been selected for the commercial MOX fuel fabrication facility, it is not possible to determine which aquatic resources would be affected. Site-specific impacts will be determined in tiered NEPA documentation.

Threatened and Endangered Species. Construction and operation of the MOX fuel fabrication facility would have the potential to impact threatened and endangered species. Sources of impacts would be similar to those discussed above for terrestrial resources, wetlands, and species (and critical habitats) that are sensitive to disturbance and whose existence may be threatened by development. During the siting process, concern for

these species would be a primary consideration. Further, once a site was chosen, consultation with the USFWS and the appropriate State agency(s) would take place to ensure that threatened and endangered species would be protected. Potential impacts to individual species, necessary consultation, and protective measures will be addressed in site-specific NEPA documentation.

4.3.5.1.7 Cultural and Paleontological Resources

This section discusses impacts to cultural and paleontological resources that may result from construction and operation of the MOX fuel fabrication facility at each of the representative sites analyzed, and a generic site. The land to be disturbed during construction would be 121 ha (300 acres) of which 81 ha (200 acres) would be used during operations. A 1.6-km (1-mi) reduced-access buffer zone would be created around the facility at all sites except ORR, where the buffer zone would be smaller. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the representative sites may be affected directly through ground disturbance during construction, building modification, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The facility would be constructed west of the 200 East Area. Although no archaeological resources were identified during surveys conducted in the adjacent 200 Areas, some may exist in the project area. If sites were identified, efforts would be made to avoid them. Operations would not result in additional impact.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified in close proximity to the 200 Areas. Resources may be identified through project-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the project area, they may exist. These resources may be affected by ground disturbing construction. Operation would not have an additional impact on paleontological resources.

Nevada Test Site

The MOX fuel fabrication facility would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed lands necessary for the proposed facility may contain similar prehistoric or historic resources. Impacts to resources would occur during construction of the proposed facility. Operation would not result in additional impact as it does not involve ground disturbance or increased activity.

The CGTO has conducted surveys over portions of Frenchman Flat and identified at least 20 plant species of importance to Native Americans. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from facility construction and operation. Potential impacts include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological remains may be affected by construction, but not operation, of the facility.

Idaho National Engineering Laboratory

The facility would be constructed adjacent to the existing ICPP security area. A surface survey of the area identified no sites within the proposed project area. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archaeological remains be discovered during construction. Two historic sites are located adjacent to the ICPP—one historic can scatter across the Big Lost River, to the northeast, and one abandoned homestead to the east. The can scatter is not considered eligible for NRHP listing and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed action. Facility construction and operation may have a visual or auditory impact on traditional use areas or sacred sites. Such resources can be identified through consultation with the interested tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain which have produced fossilized remains.

Pantex Plant

The MOX fuel fabrication facility would be constructed in Zone 11 of Pantex. Areas to be disturbed by development have not been systematically surveyed for archaeological or paleontological resources. Prior to construction, additional survey work may be necessary. Because Zone 11 is disturbed, it is unlikely to contain intact subsurface prehistoric or historic remains. Should any subsurface remains be discovered during construction, appropriate mitigation, documentation, and/or preservation measures would be conducted as necessary. Operation would not have additional impact to archaeological resources as it does not result in additional ground disturbance.

Facility construction may have an impact on historic structures at Pantex. The original buildings at Pantex were constructed between 1942 and 1945 to produce general purpose bombs. Zone 11 contains buildings, ramps, and landscape features which clearly illustrate the historic layout of a World War II bomb manufacturing line. Only two buildings within Zone 11 have been determined ineligible for listing on the NRHP. Construction may obscure the spatial relationship between these buildings, thereby compromising their historic significance. Operation of the facility is not expected to affect historic structures.

DOE has recently initiated consultation with Native American groups that have expressed interest in Pantex lands. To date, no Native American resources have been identified within Zone 11. Some resources may be identified through additional consultation. Although no mortuary remains have been discovered at Pantex to date, it is possible that some exist within the land to be disturbed by development. Burials are considered important Native American resources. Also, construction and operation may have an impact on traditionally used plant and animal species.

Important paleontological remains, such as bison and camel bones, have been found in other areas of the High Plains. The land to be disturbed during construction may contain some paleontological remains. Operation would not have an additional effect on paleontological remains.

Oak Ridge Reservation

The MOX fuel fabrication facility would be constructed adjacent to Y-12. This area has not been systematically surveyed. Although some of the land is disturbed, it may contain prehistoric or historic resources. Recorded prehistoric sites at ORR include villages, burial mounds, lithic workshops, and quarries. Historic sites recorded at ORR include both archaeological remains and standing structures. One prehistoric site, (40AN6), a lithic scatter, has been identified to the east of the Y-12 fences, near Scarboro Road. Additional prehistoric or historic

resources may occur in the project area, and these could be affected by construction. Operation, because it does not involve additional ground disturbance, is not expected to affect any prehistoric or historic resources.

Although none have been identified near Y-12 to date, facility construction and operation could have an impact on some Native American resources. For example, archaeological sites, which can be affected by construction, are sometimes considered Native American resources. In addition, the presence of a facility may create a visual intrusion into sacred or ceremonial space.

Fossilized remains occurring at ORR have little research value, so impacts to paleontological remains would be considered negligible.

Savannah River Site

The MOX fuel fabrication facility would be located approximately 1.6 km (1 mi) north of the P-Reactor Area on the east side of SRS Route F. To date, seven prehistoric sites have been located within 0.5 km (0.3 mi) of this area, so the potential for archaeological sites is moderate to high, and some NRHP-eligible resources may occur within the acreages that would be disturbed by construction. Prehistoric site types that may occur at SRS include villages, base camps, limited activity sites, quarries, and workshops. Historic site types that may occur at SRS include farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farming dikes, cattle pens, dams, towns, churches, cemeteries, trash scatters, and roads.

Some Native American resources such as remains of villages, traditional plant gathering areas, cemeteries, and isolated burials may be affected by construction and operation of the facility.

No scientifically valuable fossil remains have been recorded at SRS to date. Facility construction and operation are not expected to affect paleontological resources.

Generic Site

This facility involves the use of an area adjacent to an existing fuel fabrication facility. No impacts to prehistoric, historic, or paleontological resources are anticipated because construction would occur on previously disturbed ground. Operation could affect some Native American resources. For example, the facility could create auditory intrusion into important Native American ceremonial or sacred sites. Increased security may result in reduced access to traditional use areas. Native American resources can be identified through project-specific consultation with potentially affected tribes.

| [Text deleted.]

4.3.5.1.8 Socioeconomics

This section analyzes the socioeconomic effects of the MOX Fuel Facility for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. The effects at all of the candidate sites are found in the Supplemental Socioeconomic Data Report (Socio 1996a).

Regional Economy Characteristics. Constructing a MOX fuel facility at any of the DOE sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 475 workers in the peak year of construction at any site. The largest increase in regional employment (less than 1 percent) among the sites analyzed would be at INEL. A total of 964 new jobs (475 direct and 489 indirect) would be generated and regional unemployment would fall from 5.4 percent to 4.8 percent (Socio 1996a). The largest increase in per capita income would occur if the facility is constructed at INEL, but the increase would be much less than 1 percent.

A workforce of 500 would be required for fuel operation at any site. Operating the facility at INEL would generate the largest changes in regional employment (about 1 percent) while the largest increase in per capita income (less than 1 percent) would also occur at INEL. A total of 1,841 new jobs (500 direct and 1,341 indirect) would be generated the operational activities, and regional unemployment would fall to 4.4 percent in the INEL REA (Socio 1996a).

Population and Housing. At all of the sites analyzed, except INEL, construction requirements would be met by the available resident labor force. However, some in-migrating workers would be needed to fill specialized positions during operation at all of the sites analyzed. Increases to the population from in-migration during construction or operation would be less than 1 percent over No Action projections. Housing units, in excess of existing vacancies, would be required in the INEL ROI during construction of the project. Additional housing construction would also be required at all of the sites analyzed, except NTS and ORR, during operation to accommodate the in-migrating population. During both phases, the greatest increase in housing requirements (much less than 1 percent) would be in the INEL ROI. Historic housing construction rates indicate that there would be sufficient housing units available to accommodate the in-migrating population at all of the sites analyzed (Socio 1996a).

Community Services. Constructing the MOX fuel facility would increase demand for community services at INEL, but not at the other sites analyzed. However, operation of the facility would slightly increase the demand for community services at all of the sites analyzed. The effects of population growth due to in-migrating workers during construction or operation on community services at any of the sites analyzed would be minor. The following discussion focuses on the INEL and Pantex ROIs where the greatest increases in demand for community services is expected to occur.

To maintain the No Action student-to-teacher ratio of 18.5:1 at INEL, only one new teacher would be needed during construction. Nine additional teachers would be needed during operation in the Pantex ROI to maintain the No Action student-to-teacher ratio of 16.3:1 (Socio 1996a).

No additional police officers or firefighters would be needed to maintain No Action service levels at any of the sites analyzed during construction. One additional police officer and 3 additional firefighters would be necessary during operation to maintain the No Action level of service of 2.3 police officers and 2.3 firefighters per 1,000 persons in the Pantex ROI (Socio 1996a).

Projected hospital occupancy rates would increase slightly over the No Action levels at each site analyzed. Projected capacities would be capable of accommodating these small increases in patient load. No additional physicians would be needed at any of the sites analyzed during construction, however, 1 additional physician would be needed at INEL during operation to maintain the No Action service level of 1.2 physicians per 1,000 persons (Socio 1996a).

Local Transportation. There would be minor effects to the road networks due to construction and operation of a MOX fuel fabrication facility, but no drop in level of service. No new roads or improvements to existing roads would be needed (Socio 1996a).

Generic Site

Regional Economy Characteristics. The commercial site would require 475 and 500 workers for construction and operation of the facility, respectively. Project-related increases in per capita income and employment would be relatively small when compared to the regional economies in each REA. An analysis of the resident labor force in the REA surrounding each of the representative sites indicates that sufficient labor is available to fill these newly created positions.

Population and Housing, Community Services, and Local Transportation. There would be little or no population growth from in-migrating workers related to this project. Effects on housing, community services, and local transportation are expected to be similar to No Action projections.

4.3.5.1.9 *Public and Occupational Health and Safety*

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the MOX fuel fabrication facility, whose activities are associated with Pu disposition alternatives that utilize nuclear reactors. The section first describes the impacts from normal facility operation at each potential site, followed by a description of impacts from facility accidents.

Summaries of the radiological impacts to the public and to workers associated with normal operation are presented in Tables 4.3.5.1.9-1 and 4.3.5.1.9-2, respectively; impacts associated with the longer of the two assumed campaign times (17 years) are presented in the text. Impacts from hazardous chemicals to these same groups are given in Table 4.3.5.1.9-3. Summaries of impacts associated with postulated accidents are given in Table 4.3.5.1.9-4 through Table 4.3.5.1.9-9. Detailed results are presented in Appendix M.

The Preferred Alternative for disposition of surplus Pu is a dual technology strategy including immobilization and burning Pu as MOX fuel in existing reactors. For analysis purposes, approximately 70 percent of the surplus Pu was identified to be in forms suitable for MOX fuel fabrication. Summaries of the radiological and hazardous chemical impacts to the public and to workers associated with normal operations and with postulated accidents in this section are presented for an assumed 17-year operational campaign for the disposition of 50 t (55.1 tons) of surplus Pu and for an assumed 11-year operational campaign for the analyzed case (70 percent).

The Preferred Alternative for disposition through the utilization of existing reactors would require a shorter reactor campaign to dispose of less material with the utilization of additional reactors. The impacts and risks associated with MOX fuel fabrication would therefore be reduced since the duration of operations would coincide with the reactor campaign.

Normal Operation. There would be no radiological releases associated with the construction of a MOX fuel fabrication facility at any of the sites. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the MOX fuel fabrication facility at each of the sites are presented in Table 4.3.5.1.9-1. The impacts from all site operations, including the MOX fuel fabrication facility, are also given in the table. Comparisons with natural background radiation doses are included. Health effect values for operational periods of 11 and 17 years are presented in the table.

The doses to the MEI due to annual MOX facility operation at the identified DOE sites would range from 6.8×10^{-5} mrem at the NTS site to 6.8×10^{-3} mrem at the ORR site. From 17 years of operation, the corresponding risks of fatal cancer to this individual would range from 5.8×10^{-10} to 5.8×10^{-8} . The impacts to the average individual would be less. As a result of annual facility operation, the population doses would range from 1.4×10^{-4} person-rem at the NTS site to 0.048 person-rem at the ORR site. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 1.2×10^{-6} to 4.1×10^{-4} . For the generic site, the dose to the maximally exposed member of the public would be 0.015 mrem. From 17 years of operation, the corresponding risk of fatal cancer to this individual would be 1.3×10^{-7} . The annual population dose would

Table 4.3.5.1.9-1. Potential Radiological Impacts to the Public During Normal Operation of the Mixed Oxide Fuel Fabrication Facility

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS		Generic Site	
	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site
Annual Dose to the Maximally Exposed Individual Member of the Public^b														
Atmospheric release pathway (mrem)	1.4x10 ⁻⁴	4.4x10 ⁻³	6.8x10 ⁻⁵	4.2x10 ⁻³	8.8x10 ⁻⁵	0.018	5.2x10 ⁻⁴	5.3x10 ⁻⁴	6.8x10 ⁻³	1.5	1.5x10 ⁻³	0.42	0.015	0.073 to 0.52
Drinking water pathway	0	0	0	0	0	0	0	0	0	0.10	0	0.081	0	<1.0
Total liquid release pathway (mrem)	0	9.5x10 ⁻⁴	0	0	0	0	0	0	0	1.7	0	0.37	0	0.002 to 1.0
Atmospheric and liquid release pathways combined (mrem)	1.4x10 ⁻⁴	5.4x10 ⁻³	6.8x10 ⁻⁵	4.2x10 ⁻³	8.8x10 ⁻⁵	0.018	5.2x10 ⁻⁴	5.3x10 ⁻⁴	6.8x10 ⁻³	3.2	1.5x10 ⁻³	0.79	0.015	0.52 to 1.1
Percent of natural background ^c	4.7x10 ⁻⁵	1.8x10 ⁻³	2.2x10 ⁻⁵	1.3x10 ⁻³	2.6x10 ⁻⁵	5.3x10 ⁻⁵	1.6x10 ⁻⁴	1.6x10 ⁻⁴	2.3x10 ⁻³	1.1	5.0x10 ⁻⁴	0.27	4.9x10 ⁻³	0.18 to 0.37
17-year fatal cancer risk	1.2x10 ⁻⁹	4.6x10 ⁻⁸	5.8x10 ⁻¹⁰	3.6x10 ⁻⁸	7.5x10 ⁻¹⁰	1.5x10 ⁻⁷	4.4x10 ⁻⁹	4.5x10 ⁻⁹	5.8x10 ⁻⁸	2.8x10 ⁻⁵	1.3x10 ⁻⁸	6.7x10 ⁻⁶	1.3x10 ⁻⁷	4.4x10 ⁻⁶ to 9.5x10 ⁻⁶
11-year fatal cancer risk ^d	7.8x10 ⁻¹⁰	3.0x10 ⁻⁸	3.8x10 ⁻¹⁰	2.3x10 ⁻⁸	4.9x10 ⁻¹⁰	9.7x10 ⁻⁸	2.8x10 ⁻⁹	2.9x10 ⁻⁹	3.8x10 ⁻⁸	1.8x10 ⁻⁵	8.4x10 ⁻⁸	4.3x10 ⁻⁶	8.4x10 ⁻⁸	2.8x10 ⁻⁶ to 6.1x10 ⁻⁶
Annual Population Dose Within 80 Kilometers^e														
Atmospheric release pathway (person-rem)	6.2x10 ⁻³	0.47	1.4x10 ⁻⁴	3.9x10 ⁻³	9.7x10 ⁻⁴	2.4	2.8x10 ⁻³	3.1x10 ⁻³	0.048	29	0.044	41	0.14	0.44 to 11.2
Total liquid release pathway (person-rem)	0	1.1	0	0	0	0	0	0	0	4.7	0	3.6	0	0.050 to 0.48
Atmospheric and liquid release pathways combined (person-rem)	6.2x10 ⁻³	1.6	1.4x10 ⁻⁴	3.9x10 ⁻³	9.7x10 ⁻⁴	2.4	2.8x10 ⁻³	3.1x10 ⁻³	0.048	34	0.044	44	0.14	0.49 to 11.7
Percent of natural background ^c	3.3x10 ⁻⁶	8.4x10 ⁻⁴	1.5x10 ⁻⁶	4.2x10 ⁻⁵	1.1x10 ⁻⁶	2.7x10 ⁻³	2.4x10 ⁻⁶	2.6x10 ⁻⁶	1.3x10 ⁻⁵	9.0x10 ⁻³	1.7x10 ⁻⁵	0.017	6.7x10 ⁻⁵	2.3x10 ⁻⁴ to 5.6x10 ⁻³
17-year fatal cancers	5.3x10 ⁻⁵	0.014	1.2x10 ⁻⁶	3.3x10 ⁻⁵	8.3x10 ⁻⁶	0.020	2.4x10 ⁻⁵	2.6x10 ⁻⁵	4.1x10 ⁻⁴	0.29	3.7x10 ⁻⁴	0.37	1.2x10 ⁻³	4.1x10 ⁻³ to 0.095
11-year fatal cancers ^d	3.4x10 ⁻⁵	9.0x10 ⁻³	7.8x10 ⁻⁷	2.1x10 ⁻⁵	5.4x10 ⁻⁶	0.013	1.6x10 ⁻⁵	1.7x10 ⁻⁵	2.7x10 ⁻⁴	0.19	2.4x10 ⁻⁴	0.24	7.8x10 ⁻³	2.7x10 ⁻³ to 0.061

Table 4.3.5.1.9-1. Potential Radiological Impacts to the Public During Normal Operation of the Mixed Oxide Fuel
Fabrication Facility—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS		Generic Site	
	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site ^a	Facility	Site
Annual Dose to the Average Individual Within 80 Kilometers^f														
Atmospheric and liquid release pathways combined (mrem)	1.0x10 ⁻⁵	2.6x10 ⁻³	4.8x10 ⁻⁶	1.3x10 ⁻⁴	3.6x10 ⁻⁶	8.9x10 ⁻³	8.0x10 ⁻⁶	8.9x10 ⁻⁶	3.7x10 ⁻⁵	0.026	4.9x10 ⁻⁵	0.049	2.1x10 ⁻⁴	8.9x10 ⁻⁴ 0.014
17-year fatal cancer risk	8.5x10 ⁻¹¹	2.2x10 ⁻⁸	4.0x10 ⁻¹¹	1.1x10 ⁻⁹	3.1x10 ⁻¹¹	7.6x10 ⁻⁸	6.8x10 ⁻¹¹	7.5x10 ⁻¹¹	3.2x10 ⁻¹⁰	2.2x10 ⁻⁷	4.2x10 ⁻¹⁰	4.2x10 ⁻⁷	1.8x10 ⁻⁹	7.6x10 ⁻⁹ 1.2x10 ⁻⁷
11-year fatal cancer risk ^d	5.5x10 ⁻¹¹	1.4x10 ⁻⁸	2.6x10 ⁻¹¹	7.1x10 ⁻¹⁰	2.0x10 ⁻¹¹	4.9x10 ⁻⁸	4.4x10 ⁻¹¹	4.9x10 ⁻¹¹	1.4x10 ⁻¹⁰	1.4x10 ⁻⁷	2.7x10 ⁻¹⁰	2.7x10 ⁻⁷	1.2x10 ⁻⁹	4.9x10 ⁻⁹ 7.7x10 ⁻⁸

^a Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9 for the DOE sites and Section 3.10.9 for the generic site). The location of the MEL may be different under No Action than for operation of the MOX fuel fabrication facility. Therefore, the impacts may not be directly additive.

^b The applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR Part 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

^c The annual natural background radiation levels: (1) Hanford: the average individual receives 300 mrem; the population within 80 km receives 186,400 person-rem, (2) NTS: the average individual receives 313 mrem; the population within 80 km receives 9,190 person-rem, (3) INEL: the average individual receives 338 mrem; the population within 80 km receives 90,800 person-rem, (4) Pantex: the average individual receives 334 mrem; the population within 80 km receives 116,900 person-rem, (5) ORR: the average individual receives 295 mrem; the population within 80 km receives 379,000 person-rem, (6) SRS: the average individual receives 298 mrem; the population within 80 km receives 266,000 person-rem, (7) Generic Site: the average individual receives a dose that could range from 281 to 311 mrem; the population within 80 km receives 155,000 to 251,000 person-rem.

^d For the Preferred Alternative, for analysis purposes approximately 70 percent of the total Pu was assumed to be used for MOX fuel. As a result, the 17-year campaign for total Pu would be reduced to about an 11-year campaign for the Preferred Alternative.

^e For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

^f Obtained by dividing the population dose by the number of people projected to be living within 80 km of the site (621,000 at Hanford; 29,400 at NTS; 269,000 at INEL; 350,000 at Pantex; 1,285,000 at ORR; 893,000 at SRS; and a range of 550,000 to 807,000 at the generic site).

Note: Since the Preferred Alternative would result in the disposition of approximately 70 percent of the surplus Pu using MOX-fueled LWRs, the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced.

Source: Section M.2 for DOE sites. Refer to Section 3.10.9 for ranges associated with the generic site.

be 0.14 person-rem. The corresponding number of fatal cancers in this population from 17 years of operation would be 1.2×10^{-3} .

The doses to the MEI due to annual total site operations at the identified DOE sites are all within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. The doses would range from 4.2×10^{-3} mrem at the NTS site to 3.2 mrem at the ORR site. From 17 years of operation, the corresponding risks of fatal cancers to this individual would range from 3.6×10^{-8} to 2.8×10^{-5} . The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operation, the population doses would be within the limit in proposed 10 CFR 834, and would range from 3.1×10^{-3} person-rem at the Pantex site to 44 person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 2.6×10^{-5} to 0.37. For the generic site, the doses to the maximally exposed member of the public from annual total site operations are within radiological limits and would range from 0.52 to 1.1 mrem. From 17 years of operation, the corresponding risks of fatal cancer to this individual would range from 4.4×10^{-6} to 9.5×10^{-6} . As a result of annual total site operation, the population doses are within the proposed reporting limit and would range from 0.49 to 11.7 person-rem. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 4.1×10^{-3} to 0.095.

The radiological impacts to the public that are associated with the generic site are included in Table 4.3.5.1.9–1.

Doses to onsite workers from normal operations are given in Table 4.3.5.1.9–2. Included are involved workers directly associated with the MOX fuel fabrication facility, workers who are not involved with the MOX fuel fabrication facility and the entire workforce at each site. All doses fall within regulatory limits. Health effects are given for 11 and 17 years of facility operations.

The annual dose to MOX fuel fabrication facility workers is site-independent and would be 250 mrem to the average facility worker and 31 person-rem to the entire facility workforce. The annual dose to the average noninvolved worker would range from 2.6 mrem at the ORR site to 159 mrem at the generic site. The annual total dose to all noninvolved workers would range from 3.0 person-rem at the NTS site to 250 person-rem at Hanford. The annual dose to the total site workforces would range from 34 person-rem at the NTS site to 281 person-rem at the Hanford site. The risks and numbers of fatal cancers among the different workers from 11 and 17 years of operations are included in Table 4.3.5.1.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also workers rotations. As a result of the implementation of these litigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts from normal operation of the MOX fuel fabrication facility at several sites and a generic commercial site are presented in Table 4.3.5.1.9–3. Included are the impacts due to operation of the MOX fuel fabrication facility only, and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected, and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

The HI to the MEI due to the facility operation ranges from 4.9×10^{-6} at the NTS site to 1.9×10^{-4} at the Pantex, ORR, and generic sites. The cancer risk from hazardous chemicals to the MEI is zero (because no carcinogens are released) at all sites. The HI to the onsite worker ranges from 8.0×10^{-4} at Pantex to 1.7×10^{-3} at the ORR and generic sites, and the cancer risk to the onsite worker is zero (because no carcinogens are released hazardous chemicals) at all sites.

Table 4.3.5.1.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Mixed Oxide Fuel Fabrication Facility

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS	Generic Site
Involved Workforce^a							
Average worker dose (mrem/yr) ^b	250	250	250	250	250	250	250
17-year fatal cancer risk	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}
11-year fatal cancer risk ^c	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	1.1×10^{-3}
Total dose (person-rem/yr)	31	31	31	31	31	31	31
17-year fatal cancers	0.21	0.21	0.21	0.21	0.21	0.21	0.21
11-year fatal cancers ^c	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Noninvolved Workforce^d							
Average worker dose (mrem/yr) ^b	27	5.0	30	10	2.6	32	33 to 159
17-year fatal cancer risk	1.8×10^{-4}	3.4×10^{-5}	2.0×10^{-4}	6.8×10^{-5}	1.8×10^{-5}	2.2×10^{-4}	2.2×10^{-4} to 1.1×10^{-3}
11-year fatal cancer risk ^c	1.2×10^{-4}	2.2×10^{-5}	1.3×10^{-4}	4.4×10^{-5}	1.2×10^{-5}	1.4×10^{-4}	1.4×10^{-4} to 7.1×10^{-4}
Total dose (person-rem/yr)	250	3.0	220	14	44	226	7.0 to 98
17-year fatal cancers	1.7	0.020	1.5	0.095	0.30	1.5	0.048 to 0.67
11-year fatal cancers	1.1	0.013	0.97	0.061	0.19	0.97	0.031 to 0.43
Total Site Workforce^e							
Dose (person-rem/yr)	281	34	251	45	75	257	38 to 129
17-year fatal cancers	1.9	0.23	1.7	0.31	0.51	1.7	0.26 to 0.88
11-year fatal cancers ^c	1.2	0.15	1.1	0.20	0.33	1.1	0.17 to 0.57

^a The involved worker is a worker associated with operations of the proposed action.

^b The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

^c For the Preferred Alternative, for analysis purposes approximately 70 percent of the total Pu was assumed to be used for MOX fuel. As a result, the 17-year campaign for total Pu would be reduced to about an 11-year campaign for the Preferred Alternative.

^d The noninvolved worker is a worker onsite but not associated with operations of the proposed action. The noninvolved workforce is equivalent to the No Action workforce.

^e The impact to the total site workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Note: Since the Preferred Alternative would result in the disposition of approximately 70 percent of the surplus Pu using MOX-fueled LWRs, the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced.

Source: NRC 1995b; Section M.2.

Table 4.3.5.1.9-3. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Mixed Oxide Fuel Fabrication Facility

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS		Generic Site	
	Facility ^a	Site ^b	Facility ^a	Site ^b	Facility ^a	Site ^b	Facility ^a	Site ^b	Facility ^a	Site ^b	Facility ^a	Site ^b	Facility ^a	Site ^b
Maximally Exposed Individual (Public)														
Hazard Index ^c	3.3x10 ⁻⁵	9.5x10 ⁻⁵	4.9x10 ⁻⁶	4.9x10 ⁻⁶	7.1x10 ⁻⁵	0.015	1.9x10 ⁻⁴	5.8x10 ⁻³	1.9x10 ⁻⁴	0.040	9.0x10 ⁻⁶	5.2x10 ⁻³	1.9x10 ⁻⁴	1.9x10 ⁻⁴
Cancer risk ^d	0	0	0	0	0	3.6x10 ⁻⁶	0	1.1x10 ⁻⁸	0	0	0	1.3x10 ⁻⁷	0	0
Worker Onsite														
Hazard Index ^e	1.6x10 ⁻³	5.6x10 ⁻³	8.2x10 ⁻⁴	8.2x10 ⁻⁴	1.6x10 ⁻³	0.22	8.0x10 ⁻⁴	6.9x10 ⁻³	1.7x10 ⁻³	0.16	1.4x10 ⁻³	1.2	1.7x10 ⁻³	1.7x10 ⁻³
Cancer risk ^f	0	0	0	0	0	7.7x10 ⁻⁴	0	4.5x10 ⁻⁷	0	0	0	1.9x10 ⁻⁴	0	0

^a Facility=Contribution from the proposed new facility operation only. For the generic site, the data from the DOE site with maximum emissions and exposure was chosen.

^b Total=Includes the contributions from the No Action and the proposed new facility operation. For generic site, no hazardous chemical emission is assumed.

^c Hazard Index for MEI=sum of individual Hazard Quotients (noncancerous health effects) for MEI.

^d Cancer risk for MEI=(emissions concentrations) x (0.286 [converts concentrations to doses]) x (Slope Factor). Where there are no known carcinogens among chemicals emitted, therefore the calculated cancer risk value is 0.

^e Hazard Index for workers=sum of individual Hazard Quotients (noncancerous health effects) for workers.

^f Cancer risk for workers: (emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (Slope Factor). Where there are no known carcinogens among chemicals emitted there are no slope factors, therefore the calculated cancer risk value is 0.

Source: Section M.3, Tables M.3.4-61 through M.3.4-67.

Facility Accidents. A set of potential accidents have been postulated for a MOX fuel fabrication facility for which there may be releases of radioactivity that may impact onsite workers and the offsite population.

The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km (50 mi) of the accident release point are summarized in Tables 4.3.5.1.9–4 through 4.3.5.1.9–9 for Hanford, NTS, Pantex, ORR, INEL, and SRS. For a generic site, the accident impacts and risk at DOE sites are presented in Tables 4.3.5.1.9–4 through 4.3.5.1.9–9 and would be representative of a generic site due to the range of meteorological conditions and population densities across the analyzed DOE sites. In the event that the site boundary is less than 1,000 m (3,280 ft) from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 2.3 at ORR for the beyond design basis explosion accident scenario with a probability of 1.0×10^{-7} per year. The corresponding 17-year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 801 m (2,630 ft), would be 3.9×10^{-6} , 2.3×10^{-8} , and 1.8×10^{-8} , respectively. The maximum population 17-year facility lifetime risk would be 3.2×10^{-4} (that is, one fatality in over 50,000 years) at ORR for the design basis fire accident scenario with a probability of 5.0×10^{-4} per year. The corresponding maximum offsite individual and worker 17-year facility lifetime risks would be 1.6×10^{-6} and 1.3×10^{-6} , respectively. Section M.5 presents additional facility accident data and summary descriptions of the accident scenarios identified in Tables 4.3.5.1.9–4 through 4.3.5.1.9–9. [Text deleted.] The 17-year facility lifetime risks would range from 4.4×10^{-7} to 1.3×10^{-6} for noninvolved workers, 1.1×10^{-8} to 1.6×10^{-6} for the maximally exposed individual, and 1.8×10^{-6} to 3.2×10^{-4} for the population within 80 km, respectively. The disposition of approximately 70 percent of the surplus Pu using MOX-fueled existing LWRs would decrease the operational campaign length. As a result, the impacts for 50 t (55.1 tons) for the assumed 17-year existing LWR campaign would be proportionately reduced.

[Text deleted.]

The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires, explosions, and criticality could cause fatalities to workers close to the accident. Before construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new disposition facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is a possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

An indication of the magnitude of the impacts of an aircraft crash into a MOX fuel fabrication facility is given by the earthquake scenario. The earthquake and aircraft scenarios are similar in that they both result in major structural damage and the release of plutonium directly to the environment. They differ in that an earthquake-induced fire is based on limited combustible materials while the aircraft crash has the potential for major fuel-related fire. Also, the earthquake has the potential for damage and release of hazardous materials throughout the facility while the aircraft crash may only damage and release hazardous materials in the vicinity of the point of impact. In both scenarios, the involved workers located within the facility could receive serious or fatal injuries.

Table 4.3.5.1.9-4. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Hanford Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality per 17 yr (per 11 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 17 yr (per 11 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities per 17 yr (per 11 yr) ^a	Number of Cancer Fatalities ^c
Fire on the loading dock	1.1x10 ⁻⁶ (7.1x10 ⁻⁷)	1.3x10 ⁻⁴	4.4x10 ⁻⁸ (2.9x10 ⁻⁸)	5.1x10 ⁻⁶	8.1x10 ⁻⁵ (5.3x10 ⁻⁵)	9.3x10 ⁻³
Fire in a process cell	1.3x10 ⁻¹² (8.4x10 ⁻¹³)	7.6x10 ⁻¹⁰	5.2x10 ⁻¹⁴ (3.4x10 ⁻¹⁴)	3.0x10 ⁻¹¹	9.6x10 ⁻¹¹ (6.2x10 ⁻¹¹)	5.5x10 ⁻⁸
Impact-induced spill	2.1x10 ⁻¹⁶ (1.4x10 ⁻¹⁶)	2.7x10 ⁻¹³	8.1x10 ⁻¹⁷ (5.3x10 ⁻¹⁷)	1.1x10 ⁻¹⁴	1.5x10 ⁻¹⁴ (9.7x10 ⁻¹⁵)	1.9x10 ⁻¹¹
Deflagration inside a glovebox	2.7x10 ⁻¹⁰ (1.7x10 ⁻¹⁰)	1.6x10 ⁻⁷	1.1x10 ⁻¹¹ (7.1x10 ⁻¹²)	6.4x10 ⁻⁹	2.0x10 ⁻⁸ (1.3x10 ⁻⁸)	1.2x10 ⁻⁵
Nuclear criticality	3.5x10 ⁻¹³ (2.3x10 ⁻¹³)	2.1x10 ⁻⁷	1.4x10 ⁻¹⁴ (9.1x10 ⁻¹⁵)	8.4x10 ⁻⁹	2.9x10 ⁻¹² (1.9x10 ⁻¹²)	1.7x10 ⁻⁶
Beyond evaluation basis fire in a process cell	8.9x10 ⁻¹² (5.8x10 ⁻¹²)	5.4x10 ⁻⁶	3.7x10 ⁻¹³ (2.4x10 ⁻¹³)	2.2x10 ⁻⁷	6.7x10 ⁻¹⁰ (4.3x10 ⁻¹⁰)	3.9x10 ⁻⁴
Oxyacetylene explosion in a process cell	1.6x10 ⁻⁸ (1.0x10 ⁻⁸)	9.4x10 ⁻³	5.4x10 ⁻¹⁰ (3.5x10 ⁻¹⁰)	1.7x10 ⁻⁴	9.6x10 ⁻⁷ (6.2x10 ⁻⁷)	0.58
Beyond evaluation basis earthquake	7.0x10 ⁻⁹ (4.5x10 ⁻⁹)	4.1x10 ⁻³	2.7x10 ⁻¹⁰ (1.7x10 ⁻¹⁰)	1.6x10 ⁻⁴	4.9x10 ⁻⁷ (3.2x10 ⁻⁷)	0.29
Expected risk ^d	1.1x10 ⁻⁶ (7.1x10 ⁻⁷)	-	4.4x10 ⁻⁸ (2.9x10 ⁻⁸)	-	8.1x10 ⁻⁵ (5.3x10 ⁻⁵)	-

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 501 for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1-4 and M.5.3.2.1-5 and the MACCS computer code.

Table 4.3.5.1.9-5. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Nevada Test Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality per 17 yr (per 11 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 17 yr (per 11 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities per 17 yr (per 11 yr) ^a	Number of Cancer Fatalities ^c Accident Frequency (per yr)
Fire on the loading dock	7.4x10 ⁻⁷ (4.8x10 ⁻⁷)	8.7x10 ⁻⁵	1.7x10 ⁻⁸ (1.1x10 ⁻⁸)	2.0x10 ⁻⁶	1.8x10 ⁻⁶ (1.2x10 ⁻⁶)	2.1x10 ⁻⁴ 5.0x10 ⁻⁴
Fire in a process cell	8.9x10 ⁻¹³ (5.8x10 ⁻¹³)	5.2x10 ⁻¹⁰	2.1x10 ⁻¹⁴ (1.4x10 ⁻¹⁴)	1.2x10 ⁻¹¹	2.1x10 ⁻¹² (1.4x10 ⁻¹²)	1.3x10 ⁻⁹ 1.0x10 ⁻⁴
Impact-induced spill	1.4x10 ⁻¹⁶ (9.1x10 ⁻¹⁷)	1.9x10 ⁻¹³	3.3x10 ⁻¹⁸ (2.1x10 ⁻¹⁸)	4.3x10 ⁻¹⁵	3.4x10 ⁻¹⁶ (2.2x10 ⁻¹⁶)	4.5x10 ⁻¹³ 4.5x10 ⁻⁵
Deflagration inside a glovebox	1.8x10 ⁻¹⁰ (1.2x10 ⁻¹⁰)	1.1x10 ⁻⁷	4.3x10 ⁻¹² (2.8x10 ⁻¹²)	2.5x10 ⁻⁹	4.4x10 ⁻¹⁰ (2.9x10 ⁻¹⁰)	2.6x10 ⁻⁷ 1.0x10 ⁻⁴
Nuclear criticality	2.7x10 ⁻¹³ (1.7x10 ⁻¹³)	1.5x10 ⁻⁷	5.5x10 ⁻¹⁵ (3.6x10 ⁻¹⁵)	3.3x10 ⁻⁹	5.6x10 ⁻¹⁴ (3.6x10 ⁻¹⁴)	3.3x10 ⁻⁸ 1.0x10 ⁻⁷
Beyond evaluation basis fire in a process cell	6.3x10 ⁻¹² (4.1x10 ⁻¹²)	3.7x10 ⁻⁶	1.5x10 ⁻¹³ (9.8x10 ⁻¹⁴)	8.6x10 ⁻⁸	1.5x10 ⁻¹¹ (9.7x10 ⁻¹²)	8.9x10 ⁻⁶ 1.0x10 ⁻⁷
Oxyacetylene explosion in a process cell	1.0x10 ⁻⁸ (6.5x10 ⁻⁹)	6.3x10 ⁻³	2.1x10 ⁻¹⁰ (1.4x10 ⁻¹⁰)	1.3x10 ⁻⁴	2.2x10 ⁻⁸ (1.4x10 ⁻⁸)	0.013 1.0x10 ⁻⁷
Beyond evaluation basis earthquake	4.6x10 ⁻⁹ (3.0x10 ⁻⁹)	2.7x10 ⁻³	1.0x10 ⁻¹⁰ (6.5x10 ⁻¹¹)	6.3x10 ⁻⁵	1.1x10 ⁻⁸ (7.1x10 ⁻⁹)	6.5x10 ⁻³ 1.0x10 ⁻⁷
Expected risk ^d	7.4x10 ⁻⁷ (4.8x10 ⁻⁷)	-	1.8x10 ⁻⁸ (1.2x10 ⁻⁸)	-	1.8x10 ⁻⁶ (1.2x10 ⁻⁶)	-

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1-4 and M.5.3.2.1-5 and the MACCS computer code.

Table 4.3.5.1.9-6. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Idaho National Engineering Laboratory

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality per 17 yr (per 11 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 17 yr (per 11 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities per 17 yr (per 11 yr) ^a	Number of Cancer Fatalities ^c
Fire on the loading dock	1.0x10 ⁻⁶ (6.5x10 ⁻⁷)	1.2x10 ⁻⁴	1.1x10 ⁻⁸ (7.1x10 ⁻⁹)	1.3x10 ⁻⁶	2.4x10 ⁻⁵ (1.6x10 ⁻⁵)	2.8x10 ⁻³
Fire in a process cell	1.2x10 ⁻¹² (7.8x10 ⁻¹³)	7.1x10 ⁻¹⁰	1.3x10 ⁻¹⁴ (8.4x10 ⁻¹⁵)	7.7x10 ⁻¹²	2.8x10 ⁻¹¹ (1.8x10 ⁻¹¹)	1.7x10 ⁻⁸
Impact-induced spill	1.9x10 ⁻¹⁶ (1.2x10 ⁻¹⁶)	2.5x10 ⁻¹³	2.1x10 ⁻⁸ (1.4x10 ⁻⁸)	2.7x10 ⁻¹⁵	4.5x10 ⁻¹⁵ (2.9x10 ⁻¹⁵)	5.9x10 ⁻¹²
Deflagration inside a glovebox	2.5x10 ⁻¹⁰ (1.6x10 ⁻¹⁰)	1.5x10 ⁻⁷	2.7x10 ⁻¹² (1.7x10 ⁻¹²)	1.6x10 ⁻⁹	5.9x10 ⁻⁹ (3.8x10 ⁻⁹)	3.5x10 ⁻⁶
Nuclear criticality	3.4x10 ⁻¹³ (2.2x10 ⁻¹³)	2.0x10 ⁻⁷	3.3x10 ⁻¹⁵ (2.1x10 ⁻¹⁵)	1.9x10 ⁻⁹	7.2x10 ⁻¹³ (4.7x10 ⁻¹³)	4.3x10 ⁻⁷
Beyond evaluation basis fire in a process cell	8.9x10 ⁻¹¹ (5.8x10 ⁻¹¹)	5.1x10 ⁻⁶	9.6x10 ⁻¹⁴ (6.2x10 ⁻¹⁴)	5.5x10 ⁻⁸	2.0x10 ⁻¹⁰ (1.3x10 ⁻¹⁰)	1.2x10 ⁻⁴
Oxyacetylene explosion in a process cell	1.6x10 ⁻⁸ (1.0x10 ⁻⁸)	9.2x10 ⁻³	1.3x10 ⁻¹⁰ (8.4x10 ⁻¹¹)	8.0x10 ⁻⁵	3.0x10 ⁻⁷ (1.9x10 ⁻⁷)	0.17
Beyond evaluation basis earthquake	6.3x10 ⁻⁹ (4.1x10 ⁻⁹)	3.7x10 ⁻³	6.8x10 ⁻¹¹ (4.4x10 ⁻¹¹)	4.0x10 ⁻⁵	1.5x10 ⁻⁷ (9.7x10 ⁻⁸)	0.086
Expected risk ^d	1.0x10 ⁻⁶ (6.5x10 ⁻⁷)	-	1.1x10 ⁻⁸ (7.1x10 ⁻⁹)	-	2.4x10 ⁻⁵ (1.6x10 ⁻⁵)	-

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1-4 and M.5.3.2.1-5 and the MACCS computer code.

Table 4.3.5.1.9-7. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Pantex Plant

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality per 17 yr (per 11 yr) ^a	Probability of Cancer Fatality ^b (per 11 yr) ^a	Risk of Cancer Fatality per 17 yr (per 11 yr) ^a	Probability of Cancer Fatality ^b (per 11 yr) ^a	Risk of Cancer Fatalities per 17 yr (per 11 yr) ^a	Number of Cancer Fatalities ^c (per yr)
Fire on the loading dock	4.4x10 ⁻⁷ (2.9x10 ⁻⁷)	5.1x10 ⁻⁵	1.7x10 ⁻⁷ (1.1x10 ⁻⁷)	2.0x10 ⁻⁵	2.7x10 ⁻⁵ (1.7x10 ⁻⁵)	3.2x10 ⁻³ 5.0x10 ⁻⁴
Fire in a process cell	5.2x10 ⁻¹³ (3.4x10 ⁻¹³)	3.1x10 ⁻¹⁰	1.8x10 ⁻¹³ (1.8x10 ⁻¹³)	1.2x10 ⁻¹⁰	3.2x10 ⁻¹¹ (2.1x10 ⁻¹¹)	1.9x10 ⁻⁸ 1.0x10 ⁻⁴
Impact-induced spill	8.1x10 ⁻¹⁷ (5.3x10 ⁻¹⁷)	1.1x10 ⁻¹³	3.3x10 ⁻¹⁷ (2.1x10 ⁻¹⁷)	4.3x10 ⁻¹⁴	5.1x10 ⁻¹⁵ (3.3x10 ⁻¹⁵)	6.7x10 ⁻¹² 4.5x10 ⁻⁵
Deflagration inside a glovebox	1.1x10 ⁻¹⁰ (7.1x10 ⁻¹¹)	6.4x10 ⁻⁸	4.4x10 ⁻¹¹ (2.9x10 ⁻¹¹)	2.6x10 ⁻⁸	6.7x10 ⁻⁹ (4.3x10 ⁻⁹)	3.9x10 ⁻⁶ 1.0x10 ⁻⁴
Nuclear criticality	1.6x10 ⁻¹³ (1.0x10 ⁻¹³)	9.7x10 ⁻⁸	8.1x10 ⁻¹⁴ (5.3x10 ⁻¹⁴)	4.6x10 ⁻⁸	1.9x10 ⁻¹² (1.2x10 ⁻¹²)	1.1x10 ⁻⁶ 1.0x10 ⁻⁷
Beyond evaluation basis fire in a process cell	3.7x10 ⁻¹² (2.4x10 ⁻¹²)	2.2x10 ⁻⁶	1.5x10 ⁻¹² (9.7x10 ⁻¹³)	8.7x10 ⁻⁷	2.3x10 ⁻¹⁰ (1.5x10 ⁻¹⁰)	1.3x10 ⁻⁴ 1.0x10 ⁻⁷
Oxyacetylene explosion in a process cell	5.6x10 ⁻⁹ (3.6x10 ⁻⁹)	3.3x10 ⁻³	2.1x10 ⁻⁹ (1.4x10 ⁻⁹)	1.3x10 ⁻³	3.3x10 ⁻⁷ (2.1x10 ⁻⁷)	0.20 1.0x10 ⁻⁷
Beyond evaluation basis earthquake	2.7x10 ⁻⁹ (1.7x10 ⁻⁹)	1.6x10 ⁻³	1.1x10 ⁻⁹ (7.1x10 ⁻¹⁰)	6.4x10 ⁻⁴	1.6x10 ⁻⁷ (1.0x10 ⁻⁷)	0.098 1.0x10 ⁻⁷
Expected risk ^d	4.4x10 ⁻⁷ (2.9x10 ⁻⁷)	-	1.8x10 ⁻⁷ (1.2x10 ⁻⁷)	-	2.7x10 ⁻⁵ (1.7x10 ⁻⁵)	-

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1-4 and M.5.3.2.1-5 and the MACCS computer code.

Table 4.3.5.1.9-8. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Oak Ridge Reservation

	Worker at 801 m		Maximum Offsite Individual		Population to 80 km		
	Risk of Cancer Fatality per 17 yr (per 11 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 17 yr (per 11 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities per 17 yr (per 11 yr) ^a	Number of Cancer Fatalities ^c	Accident Frequency (per yr)
Accident Description							
Fire on the loading dock	1.3x10 ⁻⁶ (8.4x10 ⁻⁷)	1.4x10 ⁻⁴	1.6x10 ⁻⁶ (1.0x10 ⁻⁶)	1.8x10 ⁻⁴	3.2x10 ⁻⁴ (2.1x10 ⁻⁴)	0.037	5.0x10 ⁻⁴
Fire in a process cell	1.5x10 ⁻¹² (9.7x10 ⁻¹³)	8.7x10 ⁻¹⁰	1.8x10 ⁻¹² (1.2x10 ⁻¹²)	1.1x10 ⁻⁹	3.8x10 ⁻¹⁰ (2.5x10 ⁻¹⁰)	2.2x10 ⁻⁷	1.0x10 ⁻⁴
Impact-induced spill	2.4x10 ⁻¹⁶ (1.6x10 ⁻¹⁶)	3.1x10 ⁻¹³	3.0x10 ⁻¹⁶ (1.9x10 ⁻¹⁶)	3.8x10 ⁻¹³	6.0x10 ⁻¹⁴ (3.9x10 ⁻¹⁴)	7.9x10 ⁻¹¹	4.5x10 ⁻⁵
Deflagration inside a glovebox	3.1x10 ⁻¹⁰ (2.0x10 ⁻¹⁰)	1.8x10 ⁻⁷	3.8x10 ⁻¹⁰ (2.5x10 ⁻¹⁰)	2.3x10 ⁻⁷	8.1x10 ⁻⁸ (5.3x10 ⁻⁸)	4.6x10 ⁻⁵	1.0x10 ⁻⁴
Nuclear criticality	3.9x10 ⁻¹⁰ (2.5x10 ⁻¹⁰)	2.3x10 ⁻⁷	4.9x10 ⁻¹³ (3.2x10 ⁻¹³)	2.9x10 ⁻⁷	3.4x10 ⁻¹¹ (2.2x10 ⁻¹¹)	2.0x10 ⁻⁵	1.0x10 ⁻⁷
Beyond evaluation basis fire in a process cell	1.0x10 ⁻¹¹ (6.5x10 ⁻¹²)	6.2x10 ⁻⁶	1.3x10 ⁻¹¹ (8.4x10 ⁻¹²)	7.7x10 ⁻⁶	2.7x10 ⁻⁹ (1.7x10 ⁻⁹)	1.6x10 ⁻³	1.0x10 ⁻⁷
Oxyacetylene explosion in a process cell	1.8x10 ⁻⁸ (1.2x10 ⁻⁸)	0.011	2.3x10 ⁻⁸ (1.5x10 ⁻⁸)	0.013	3.9x10 ⁻⁶ (2.5x10 ⁻⁶)	2.3	1.0x10 ⁻⁷
Beyond evaluation basis earthquake	7.4x10 ⁻⁹ (4.8x10 ⁻⁹)	4.5x10 ⁻³	9.6x10 ⁻⁹ (6.2x10 ⁻⁹)	5.6x10 ⁻³	1.9x10 ⁻⁶ (1.2x10 ⁻⁶)	1.2	1.0x10 ⁻⁷
Expected risk ^d	1.3x10 ⁻⁶ (8.4x10 ⁻⁷)	-	1.6x10 ⁻⁶ (1.0x10 ⁻⁶)	-	3.2x10 ⁻⁴ (2.1x10 ⁻⁴)	-	-

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 801 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [801 m for the facility at ORR], whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the P₁ was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1-4 and M.5.3.2.1-5 and the MACCS computer code.

Table 4.3.5.1.9-9. Mixed Oxide Fuel Fabrication Facility Accident Impacts at Savannah River Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Cancer Fatality per 17 yr (per 11 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatality per 17 yr (per 11 yr) ^a	Probability of Cancer Fatality ^b	Risk of Cancer Fatalities per 17 yr (per 11 yr) ^a	Number of Cancer Fatalities ^c
Fire on the loading dock	7.1x10 ⁻⁷ (4.6x10 ⁻⁷)	8.4x10 ⁻⁵	2.5x10 ⁻⁸ (1.6x10 ⁻⁸)	2.9x10 ⁻⁶	8.1x10 ⁻⁵ (5.3x10 ⁻⁵)	9.9x10 ⁻³
Fire in a process cell	8.9x10 ⁻¹³ (5.8x10 ⁻¹³)	5.0x10 ⁻¹⁰	3.0x10 ⁻¹⁴ (1.9x10 ⁻¹⁴)	1.8x10 ⁻¹¹	1.0x10 ⁻¹⁰ (6.5x10 ⁻¹¹)	5.9x10 ⁻⁸
Impact-induced spill	1.3x10 ⁻¹⁶ (8.4x10 ⁻¹⁷)	1.8x10 ⁻¹³	4.7x10 ⁻¹⁸ (3.0x10 ⁻¹⁸)	6.2x10 ⁻¹⁵	1.6x10 ⁻¹⁴ (1.0x10 ⁻¹⁴)	2.1x10 ⁻¹¹
Deflagration inside a glovebox	1.8x10 ⁻¹⁰ (1.8x10 ⁻¹⁰)	1.0x10 ⁻⁷	6.2x10 ⁻¹² (4.0x10 ⁻¹²)	3.7x10 ⁻⁹	2.1x10 ⁻⁸ (1.4x10 ⁻⁸)	1.2x10 ⁻⁵
Nuclear criticality	2.4x10 ⁻¹³ (1.5x10 ⁻¹³)	1.4x10 ⁻⁷	7.4x10 ⁻¹⁵ (4.8x10 ⁻¹⁵)	4.5x10 ⁻⁹	3.8x10 ⁻¹² (2.5x10 ⁻¹²)	2.3x10 ⁻⁶
Beyond evaluation basis fire in a process cell	6.1x10 ⁻¹² (4.0x10 ⁻¹²)	3.6x10 ⁻⁶	2.1x10 ⁻¹³ (1.4x10 ⁻¹³)	1.2x10 ⁻⁷	7.2x10 ⁻¹⁰ (4.7x10 ⁻¹⁰)	4.2x10 ⁻⁴
Oxyacetylene explosion in a process cell	9.6x10 ⁻⁹ (6.2x10 ⁻⁹)	5.8x10 ⁻³	3.1x10 ⁻¹⁰ (2.0x10 ⁻¹⁰)	1.8x10 ⁻⁴	1.0x10 ⁻⁶ (6.5x10 ⁻⁷)	0.62
Beyond evaluation basis earthquake	4.7x10 ⁻⁹ (3.0x10 ⁻⁹)	2.8x10 ⁻³	1.6x10 ⁻¹⁰ (1.0x10 ⁻¹⁰)	9.1x10 ⁻⁵	5.2x10 ⁻⁷ (3.4x10 ⁻⁷)	0.31
Expected risk ^d	7.2x10 ⁻⁷ (4.7x10 ⁻⁷)	-	2.5x10 ⁻⁸ (1.6x10 ⁻⁸)	-	8.9x10 ⁻⁵ (5.8x10 ⁻⁵)	-

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of years of operation.

^b Increased likelihood (or probability) of cancer fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: For the Preferred Alternative, for analysis purposes approximately 70 percent of the Pu was assumed to be used for MOX, and the operational campaign would decrease. As a result, the impacts projected in this table for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced; all values are mean values.

Source: Calculated using the source term in Tables M.5.3.2.1-4 and M.5.3.2.1-5 and the MACCS computer code.

4.3.5.1.10 Waste Management

This section summarizes the impacts for the construction and operation of a MOX fuel fabrication facility. There is no spent nuclear fuel or HLW associated with a MOX fuel fabrication facility. Table 4.3.5.1.10–1 provides the estimated operational waste volumes projected to be generated at the DOE sites analyzed and a generic site as a result of the MOX fuel fabrication facility. Facilities that would support the MOX fuel fabrication facility would treat and package all generated waste into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes at DOE sites could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated onsite to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice. The projected incremental waste volumes generated from a MOX fuel fabrication facility and the resultant waste effluent that was used for the waste impact analysis can be found in Section E.3.2.3. A detailed description of the waste management activities that would be required to support the MOX fuel fabrication facility can also be found in Section E.3.2.3.

Construction and operation of a MOX fuel fabrication facility would impact existing waste management activities at each of the DOE sites analyzed and a generic commercial site, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Waste generated during construction would consist of wastewater, and solid nonhazardous and liquid hazardous wastes. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any contaminated soil is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

Transuranic and mixed TRU wastes would be generated from Pu oxide purification, fuel fabrication, and material recycle. Following treatment and volume reduction, approximately 306 m³ (400 yd³) of TRU and 4 m³ (5 yd³) mixed TRU wastes consisting of filters, resins, job control waste, process equipment, and sweepings would require treatment and packaging to meet the current planning-basis WIPP WAC. This waste would be treated and packaged in a facility constructed with the MOX plant at ORR, NTS, Pantex, and the commercial MOX facility, or in an expanded central facility at the Hanford, INEL, or SRS sites. This waste would also require storage facilities where it could be staged until it would be shipped to WIPP or an alternate facility for disposal. To transport TRU waste to WIPP or an alternate facility, 36 additional truck shipments per year or, if applicable, 18 regular train shipments or 6 dedicated train shipments per year would be required.

All the sites analyzed have facilities to handle LLW. The approximately 153 m³ (200 yd³) of LLW generated in materials purification, uranium and Pu oxide processing and preparation, and rod pressing and processing would consist of contaminated job control waste, filters, and process equipment. This waste quantity is small in comparison to the No Action waste volumes disposed of at Hanford, INEL, NTS, ORR, and SRS. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.05 ha/yr (0.1 acre/yr) at Hanford and ORR, 0.03 ha/yr (0.06 acre/yr) at INEL and NTS, and 0.02 ha/yr (0.04 acre/yr) at SRS. Pantex and the generic commercial MOX facility would require nine LLW shipments per year to NTS or a commercial disposal facility, respectively. A commercial LLW disposal facility would require approximately 0.01 ha/yr (0.02 acre/yr) to dispose of this waste. For DOE sites, the ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

Less than 1 m³ (200 gal) of liquid and 38 m³ (50 yd³) of solid mixed LLW is estimated to be generated in the MOX fuel fabrication facility. Mixed LLW would consist of radioactively-contaminated solvents, lead, and scintillation vials. All the sites analyzed have the capacity to treat mixed LLW. [Text deleted.] Mixed LLW

Table 4.3.5.1.10-1. Estimated Annual Generated Waste Volumes for the Mixed Oxide Fuel Fabrication Facility^a

Category	New Facility		Hanford		NTS		INEL		Pantex		ORR		SRS		Generic Site	
	(m ³)	No Action (m ³)	(m ³)	No Action (m ³)	(m ³)	No Action (m ³)	(m ³)	No Action (m ³)	(m ³)	No Action (m ³)	(m ³)	No Action (m ³)	(m ³)	No Action (m ³)	(m ³)	No Action (m ³)
Transuranic																
Liquid	0	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Solid	306	271	None	None	None	3.5	119	None	None	None	None	338	None	None	None	None
Mixed Transuranic																
Liquid	0	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Solid	4	98	None	None	None	Included in TRU	None	None	None	None	None	Included in TRU	None	None	None	None
Low-Level																
Liquid	4 ^b	None	None	Dependent on restoration activities	None	None	2,970	8	74,000	None	74,000	None	74,000	None	4	4
Solid	153	3,390	15,000	7,200	32	16,400	41	None	None	None	None	None	None	None	None	None
Mixed Low-Level																
Liquid	0.8	3,760	None	4	87,600	1,330	0.8	None	None	None	None	None	None	None	None	None
Solid	38	1,505	50	170	432	7,700	2	None	None	None	None	None	None	None	None	None
Hazardous																
Liquid	4	Included in solid	Included in solid	Included in solid	2	6,460	4	None	None	None	None	None	None	None	None	None
Solid	153	560	212	1,200	26	15,100	153	None	None	None	None	None	None	None	None	None
Nonhazardous (Sanitary)																
Liquid	43,300	414,000	Not reported separately; included in solid	Not reported separately; included in solid	141,000	550,000	6,910	None	None	None	None	None	None	None	None	None
Solid	76	5,107	2,120	52,000	339	53,100	246	None	None	None	None	None	None	None	None	None
Nonhazardous (Other)																
Liquid	227	Included in sanitary	None	None	Included in sanitary	650,000	264	None	None	None	None	Included in sanitary	264	None	None	None
Solid	84 ^c	Included in sanitary	76,500	Included in sanitary	321	Included in sanitary	84 ^c	None	None	None	None	Included in sanitary	84 ^c	None	None	None

^a The No Action volumes are from Tables 4.2.1.10-1, 4.2.2.10-1, 4.2.3.10-1, 4.2.4.10-1, 4.2.5.10-1, and Section 3.10.10. Incremental waste generation volumes for MOX Fuel Fabrication facility are from Table E.3.2.3-1. Waste effluent volumes (that is, after treatment and volume reduction) that are used in the narrative description of the impacts are also provided in Table E.3.2.3-1.

^b Liquid LLW would be treated and solidified prior to disposal.

^c Includes recyclable wastes.

would be managed in accordance with the Tri-Party Agreement for Hanford, and the respective site treatment plans that were developed to comply with the *Federal Facility Compliance Act* for the remainder of the DOE sites. Mixed LLW would be managed in accordance with the NRC license conditions and other applicable requirements for the generic commercial site.

Approximately 4 m³ (1,000 gal) of liquid and 153 m³ (200 yd³) of solid hazardous waste would be generated in the MOX fuel fabrication facility from the use of chemical and organic lubricants, coolants, solvents, and paints. Accommodation in existing facilities is feasible at Hanford, INEL, and ORR, though expansion may be required. Additional RCRA-permitted staging facilities would be required at NTS, Pantex, SRS, and the generic facility, where the hazardous waste would be stored pending onsite or offsite treatment at a RCRA-permitted facility.

Approximately 43,500 m³ (11.5 million gal) of liquid nonhazardous sanitary, industrial, and other wastewater would require treatment in accordance with site practice and discharge permits. This waste would require a separate treatment facility at Hanford, INEL, and NTS, since these sites do not have centralized nonhazardous wastewater treatment facilities. At ORR, Pantex, and SRS, the plant or central wastewater facilities have the capacity to accommodate this increased flow. The generic MOX fuel fabrication facility may require expansion of the wastewater treatment facilities to handle this flow, or it may be possible to accommodate the increase in a public treatment facility. The approximately 76 m³ (100 yd³) of solid sanitary and industrial nonhazardous waste, and 84 m³ (110 yd³) of other nonhazardous waste generated by the MOX fuel fabrication facility is a small fraction of the solid nonhazardous wastes normally handled at any of the sites analyzed for this action, and would be recycled or shipped to onsite or offsite disposal facilities in accordance with site-specific practice.

4.3.5.2 Existing Light Water Reactor Alternative

The environmental impacts described in the following sections are based on the analysis of the existing LWR facility for the Existing LWR Alternative described in Section 2.4.5.2. This alternative would require the operation of a minimum of three LWRs, which could be located at the same or different sites. Environmental impacts for this facility are described in the context of a generic range of conditions that could exist at potential locations.

In accordance with the Preferred Alternative for surplus Pu disposition, three to five existing LWRs could be selected to disposition the surplus Pu. As a results of implementing a multiple technology disposition strategy, for analysis purposes, approximately 70 percent of the surplus would be used as MOX fuel in existing LWRs. As many as five sites with one reactor each or as few as one site with three reactors could be used for Pu disposition. If there are multiple reactors at a site, the impacts in the Sections 4.3.5.2.1 through 4.3.5.2.10 would be approximately doubled for two reactors or tripled for three reactors.

4.3.5.2.1 Land Resources

Land Use. No additional direct impacts to land use would occur from operations. As discussed in Section 4.3.5.2.2, a small addition to the fuel receiving and storage buildings may be required for the existing LWR to properly handle MOX fuel. If required, this addition would be a minor change to the plant profile and would be anticipated to utilize land area previously disturbed. Therefore, any new construction would be inconsequential. Additional land area would not be required for a buffer zone and there would be no change in land use. Site development would be in conformance with site development/facility utilization plans as well as land-use plans, policies, and controls at the Federal, State, and local levels.

The use of MOX fuel in an existing LWR would not affect the use of other onsite lands (for example, buffer/undeveloped land areas would not be encroached upon). Site land use would be compatible with offsite land uses, including the use of special status land. Prime farmland would also not be affected. As discussed in Section 4.3.5.2.8, no in-migration of workers would occur during operations. Therefore, no indirect impacts to offsite lands would occur.

Visual Resources. No additional impacts to visual resources would occur from operations. Current VRM classification of the developed area of the site would be maintained and would likely be a Class 5. Facility operations, such as stack plumes, could continue to be visible from lands with high sensitivity levels, such as public roadways, urbanized areas, and recreational/scenic areas. However, this would not represent a change (that is, increase in magnitude or extent) from the existing condition.

4.3.5.2.2 Site Infrastructure

The existing LWR site infrastructure would remain essentially unchanged from the conditions described in Section 3.11.2 (see Table 4.3.5.2.2-1). A small addition to the fuel receiving and storage buildings may be required for the existing LWR to properly handle the MOX fuel. However, because this is only a minor change to the plant profile, existing LWR site infrastructure would not be impacted by the change to MOX fuel. The site is served with water and an existing power distribution system that would adequately support the power demands of plant equipment and employee facilities.

Table 4.3.5.2.2-1. Additional Site Infrastructure Needed for the Operation of One Existing Light Water Reactor (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	5 to 20	0 to 12	700,000 to 1,100,000	96 to 140	Approximately 757,000	0	0
Range of resource availability ^a	5 to 20	0 to 12	700,000 to 1,100,000	96 to 140	Approximately 757,000	0	0
Amount required in excess of low-end range of available resources	0	0	0	0	0	0	0

^a The existing site infrastructure would remain essentially unchanged.

Source: ORNL 1995b.

4.3.5.2.3 *Air Quality and Noise*

Operations related to the existing LWR facility would continue to generate criteria pollutants. Impacts for radiological airborne emissions are discussed in Section 4.3.5.2.9.

Noise impacts during operation are expected to be low. Air quality and noise impacts for this disposition alternative are described separately. Supporting data for the air quality and noise analyses are presented in Appendix F.

AIR QUALITY

The operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

Emission rates for operation of the existing LWR are presented in Table F.1.3–12. Air pollutant emissions sources associated with operations include:

- Operation of diesel generators and periodic testing of emergency diesel generators
- [Text deleted.]
- Small quantities of toxic/hazardous pollutant emissions from facility operations

During operation, concentrations of criteria and toxic/hazardous air pollutants are expected to continue to be in compliance with Federal, State, and local air quality regulations or guidelines. No additional operation or testing of diesel generators or emissions from support facilities would be expected to occur from the use of MOX fuel. Pollutant concentrations from operating an existing LWR with a MOX core rather than a uranium core would not change, as shown in Table F.1.3–12. The process would remain the same, and criteria and toxic/hazardous emissions are not related to the type of fuel being used (NRC 1996b:2-22).

NOISE

The location of the facilities associated with the existing LWR facility relative to the site boundary and sensitive receptors was examined in order to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts.

Non-traffic noise sources associated with reactor operation of these facilities include ventilation systems, cooling systems, vents, pumps, motors, emergency diesel generators, transformers, paging systems, and material handling equipment. There would be no discernible increase in noise levels as a result of operating an existing LWR with a MOX core rather than a uranium core.

4.3.5.2.4 *Water Resources*

Utilizing excess Pu as fuel in an existing commercial LWR should not cause any impacts to water resources outside of those identified in the site-specific environmental impact statements which have been prepared for these facilities. There would be no noticeable changes to current use of water resources. The facilities would continue to obtain raw water from either surface or groundwater sources that have an adequate supply to support them. Wastewater would continue to be treated, monitored, and discharged.

4.3.5.2.5 *Geology and Soils*

There would be no impacts to the geologic and soil resources resulting from the utilization of existing LWRs. A range of conditions from applicable sites were evaluated and used as the basis for this assessment. No ground-disturbing construction activities are proposed for this alternative although there would be modification of an existing building. Therefore, no construction or operational effects to the geologic and soil resource are anticipated, and no direct or indirect effects to the geologic or soil resource are anticipated.

4.3.5.2.6 *Biological Resources*

Representative existing LWR sites that could be utilized for the disposition of Pu in a MOX-fueled reactor are located within a number of the principal vegetation types, including deciduous forest, grassland, desert, and southeast evergreen forest. These principal vegetation types are described in Sections 3.10.6 and 3.11.6.

The use of an existing LWR to burn MOX fuel would not be expected to result in any additional impacts to biological resources at the selected site. This is the case since the reactor and all associated facilities are in place and operational. Although an addition to the fuel receiving and storage building may be required, construction would take place within a previously disturbed area of the site. Also, the design and operation of cooling and auxiliary water systems would not be affected by the use of MOX fuel. Thus, entrainment, impingement, and thermal impacts to aquatic organisms, or salt drift impacts to vegetation and soil, would not be expected to increase. Consultation with USFWS and State agencies would be conducted at the site-specific level, as appropriate.

4.3.5.2.7 *Cultural and Paleontological Resources*

This section discusses impacts to cultural and paleontological resources potentially resulting from the use of an existing LWR. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Utilization of an existing LWR is not expected to affect cultural or paleontological resources. Minor building modifications and ground-breaking activities are proposed, but new construction would be adjacent to existing facilities on previously disturbed ground. It is unlikely that the area contains NHRP-eligible or paleontological resources. No impacts to Native American resources are expected.

4.3.5.2.8 Socioeconomics

This section describes the potential socioeconomic effects resulting from the use of MOX as fuel in existing light water reactors. Representative sites, varying in size from one to three reactors, were selected for analysis.

Regional Economy Characteristics. Operation activities at these sites would create between 40 and 105 total new jobs (direct and indirect) for each reactor. Positions required during operation of any of these facilities would be filled by the REA's existing workforce, and there should not be any in-migration to the ROI as a result of this alternative. There would be a negligible increase in the REA's local economy and per capita income, and unemployment rates would decrease minimally (Socio 1996a).

Population and Housing, Community Services, and Local Transportation. There would be no in-migrating workers and therefore no impacts to population and housing or community services. There would also be no impacts to the local transportation networks.

4.3.5.2.9 Public and Occupational Health and Safety

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with an existing commercial LWR whose core would be fueled with MOX instead of uranium oxide alone. The section first describes the impacts from normal facility operation of the MOX fueled reactor for a representative sample of existing commercial LWR sites followed by a description of impacts from reactor accidents at a generic site. The impacts associated with the ultimate disposal of the spent nuclear fuel form in a HLW repository are presented separately in technical documents that specifically address repository operations.

Summaries of the radiological impacts to the public and to workers associated with normal operation are presented in Tables 4.3.5.2.9-1 and 4.3.5.2.9-2, respectively; impacts associated with the applicable time duration (17 years, the assumed campaign time or 11 years for the Preferred Alternative) are presented in the text. Summaries of impacts associated with postulated accidents are given in Tables 4.3.5.2.9-3 and 4.3.5.2.9-4. Detailed results are presented in Appendix M.

The Preferred Alternative for disposition of surplus Pu is a dual technology strategy including immobilization and burning Pu as MOX fuel in existing reactors. Approximately 70 percent of the surplus Pu was identified to be in forms suitable for MOX fuel fabrication. Summaries of the radiological and hazardous chemical impacts to the public and to workers associated with normal operations and with postulated accidents in this section are presented for an assumed 17-year operational campaign for the disposition of 50 t (55.1 tons) of surplus Pu and for an assumed 11-year operational campaign for the analyzed case (70 percent).

The Preferred Alternative for disposition through the utilization of existing reactors would require a shorter reactor campaign to dispose of less material with the utilization of additional reactors. The impacts and risks associated with MOX fuel fabrication would therefore be reduced since the duration of operations would coincide with the reactor campaign.

Normal Operation. During normal operation of an existing LWR with a MOX core, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Table 4.3.5.2.9-1 presents the reported radiological impacts to the general public resulting from operation of the existing LWRs with uranium cores in 1994. Impacts involved in changing the core from a uranium core to a MOX core are also presented. To put the operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

The doses and resulting fatal cancer risks to both the average and the maximally exposed member of the public, and also to the population, from annual commercial LWR operation with a MOX-fueled core would not be significantly different than present operations with a uranium core.

The dose to the maximally exposed member of the public from annual total site operations would be maintained within the radiological limits specified in Appendix I to 10 CFR 50 and 40 CFR 190 (if the reactor is licensed by NRC). This dose is estimated to be less than 0.17 mrem from all pathways. From 17 years of operation, the corresponding fatal cancer risk for this individual would be less than 1.5×10^{-6} . The impacts to the average individual would be much less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operation, the population dose would be less than 2.0 person-rem. The corresponding number of fatal cancers in this population from 17 years of operation would be less than 0.017.

Table 4.3.5.2.9-1. Potential Radiological Impacts to the Public During Normal Operation of the Existing Light Water Reactor

Receptor	Reactor Using MOX Core	
	Increment ^b	Total Site ^c
No Action (Reactors Using UO ₂ Core) ^a		
Annual Dose to the Maximally Exposed Individual Member of the Public ^d		
Atmospheric release pathway (mrem)	2.5x10 ⁻⁵ to 0.023	4.4x10 ⁻⁴ to 0.10
Total liquid release pathway (mrem)	-0.020 to -2.8x10 ⁻⁴	2.8x10 ⁻⁴ to 0.075
Atmospheric and liquid release pathways combined (mrem)	-1.1x10 ⁻² to 0.020	7.2x10 ⁻⁴ to 0.17
Percent of natural background ^e	-3.8x10 ⁻³ to 6.8x10 ⁻³	2.4x10 ⁻⁴ to 0.059
17-year fatal cancer risk	-9.6x10 ⁻⁸ to 1.7x10 ⁻⁷	5.9x10 ⁻⁹ to 1.5x10 ⁻⁶
11-year fatal cancer risk ^f	-6.2x10 ⁻⁸ to 1.1x10 ⁻⁷	3.7x10 ⁻⁴ to 9.7x10 ⁻⁷
Annual Population Dose Within 80 Kilometers		
Atmospheric release pathway (person-rem)	1.3x10 ⁻³ to 0.20	0.022 to 1.6
Total liquid release pathway (person-rem)	-0.48 to 0.0	0.0 to 1.7
Atmospheric and liquid release pathways combined (person-rem)	-0.046 to 0.20	0.022 to 2.0
Percent of natural background ^e	-6.0x10 ⁻⁵ to 3.4x10 ⁻⁵	4.3x10 ⁻⁶ to 2.6x10 ⁻⁴
17-year fatal cancers	-3.8x10 ⁻³ to 1.7x10 ⁻⁴	1.8x10 ⁻⁴ to 0.017
11-year fatal cancers ^f	-2.5x10 ⁻³ to 1.1x10 ⁻⁴	1.2x10 ⁻⁴ to 0.011
Annual Dose to the Average Individual Within 80 Kilometers ^g		
Atmospheric and liquid release pathways combined (mrem)	-1.8x10 ⁻⁴ to 1.0x10 ⁻⁴	1.3x10 ⁻⁵ to 7.8x10 ⁻⁴
17-year fatal cancer risk	-1.5x10 ⁻⁹ to 8.9x10 ⁻¹⁰	1.0x10 ⁻¹⁰ to 6.7x10 ⁻⁹
11-year fatal cancer risk ^f	-9.7x10 ⁻¹⁰ to 5.8x10 ⁻¹⁰	6.5x10 ⁻¹¹ to 4.3x10 ⁻⁹

^a The No Action doses are based on 1994 reported doses from operation of all reactors at a site.

^b Incremental doses represent the change in doses involved in changing from a uranium core to a MOX core.

^c Combined or total impacts do not necessarily equal the sum of the individual components because different sites may be involved.

^d The standards for individual members of the public are given in Appendix I to 10 CFR 50 and 40 CFR 190 for NRC licensed reactors. As discussed in Appendix I, 5 mrem/yr is the airborne emission guideline and 3 mrem/yr per reactor is the liquid release guideline. Meeting these guideline values serves as a numerical demonstration that doses are as low as reasonably achievable. A total dose of 25 mrem/yr is the limit from all pathways combined, as given in 40 CFR 190. If the reactor is owned by DOE, the applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways as required by NESHAPS (40 CFR Part 61, Subpart H) under the CAA, 4 mrem per year from the drinking water pathway as required by the SDWA, and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

^e Annual natural background radiation levels: the average individual receives a dose that could range from 296 to 299 mrem; the population within 80 km in the year 1994 received a dose that could have ranged from 130,000 to 760,000 person-rem.

^f For the Preferred Alternative, for analysis purposes approximately 70 percent of the total surplus Pu was assumed to be used in existing LWRs. As a result, the 17-year campaign for the total Pu would be reduced to about an 11-year campaign for the Preferred Alternative.

[Text deleted.]

^g Obtained by dividing the population dose by the number of people living within 80 km of the site (450,000 to 2,600,000).

Source: Section M.2.

Table 4.3.5.2.9–2. Potential Radiological Impacts to the Workers During Normal Operation of the Existing Light Water Reactor

Receptor	No Action (Reactor Using UO ₂ Core) ^a	Reactor Using MOX Core	
		Increment ^b	Reactor Total ^c
Commercial LWR Workforce			
Average worker dose (mrem/yr) ^d	280 to 540	1.3 to 2.7	281 to 543
17-year risk of fatal cancer	1.9x10 ⁻³ to 3.7x10 ⁻³	8.9x10 ⁻⁶ to 1.8x10 ⁻⁵	1.9x10 ⁻³ to 3.7x10 ⁻³
11-year risk of fatal cancer ^e	1.2x10 ⁻³ to 2.4x10 ⁻⁴	5.8x10 ⁻⁶ to 1.2x10 ⁻⁵	1.2x10 ⁻³ to 2.4x10 ⁻³
Total dose (person-rem/yr)	170 to 600	1.6	172 to 602
17-year fatal cancers	1.2 to 4.1	0.011	1.2 to 4.1
11-year risk of fatal cancer ^e	0.78 to 2.7	7.1x10 ⁻³	0.78 to 2.7
Total Site Workforce ^f			
Total dose (person-rem/yr)	327 to 1,190	1.6 to 4.8	331 to 1,193
17-year risk of fatal cancer	2.2 to 8.1	0.011 to 0.033	2.2 to 8.1
11-year fatal cancers ^e	1.4 to 5.2	7.1x10 ⁻³ to 0.021	1.4 to 5.2

^a The No Action doses are based on measured doses from 1988 to 1993.

^b The incremental doses represent the estimated increase in worker doses involved in changing from a uranium core to a MOX core.

^c Combined or total impacts do not necessarily equal the sum of the individual components because different sites may be involved.

[Text deleted.]

^d The radiological limit for an individual worker is 5,000 mrem/yr (10 CFR 20).

^e For the Preferred Alternative, for analysis purposes approximately 70 percent of the total surplus Pu was assumed to be used in existing LWRs. The 17-year campaign for the total surplus Pu would be reduced to about an 11-year campaign.

^f The impact to the total site workforce is the result of conversion of all reactors at the site to the burning of MOX fuel.

[Text deleted.]

Note: The number of significant figures used in the impact values is dictated by the addition of small incremental values to relatively large No Action values.

Source: Section M.2.

Doses to onsite workers from normal operations with a uranium-fueled core are given in Table 4.3.5.2.9–2. Estimated incremental and total impacts to onsite workers resulting from a MOX core instead of a uranium core are also given. Included are involved workers directly associated with the operation of one MOX-fueled reactor, and the entire workforce if all the reactors at a generic site were converted to burn MOX fuel. All doses fall within regulatory limits. [Text deleted.]

The annual dose from operation of a reactor with a MOX core would range from 281 to 543 mrem to the average reactor worker and from 172 to 602 person-rem to the entire reactor workforce. The annual dose to the total site workforce would range from 331 to 1,193 person-rem. The risks and numbers of fatal cancers among the different workers from 17 years and 11 years of operation are included in Table 4.3.5.2.9–2. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also worker rotations. As a result of the implementation of these mitigation measures, the potential fatal cancers for the operation of this facility would be lower than calculated.

Hazardous Chemical Impacts. Existing commercial light reactors are currently in operation. If a change were made from burning uranium-based fuel to burning MOX fuel, which is part U and part Pu, the nonradiological chemical emissions would not change. Therefore the HIs and cancer risks would not change, which means the incremental HIs and cancer risks would be zero. There would be no incremental increase in the potential hazardous chemical impact to the public and workers from normal operations of existing commercial light water reactors would be lower than calculated.

Facility Accidents. The risks associated with existing commercial LWRs has been studied by the operating organizations in accordance with NRC guidance. The safety of these reactors has been analyzed and reported

by plant operators in such documents as SARs and probabilistic risk assessments. In addition, the NRC has conducted probabilistic risk assessments on five existing reactors and issued the report *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants* (NUREG-1150). According to this report, the estimated mean core damage frequencies would range from 4.0×10^{-6} to 3.4×10^{-4} caused by internal events (not including natural phenomena). Should such core damage occur, the potential consequences would range from 71 to 1,022 latent cancer fatalities for the offsite population according to this NRC report. The estimated risks to the offsite population from these accidents would range from 9.6×10^{-4} to 2.4×10^{-2} .

Reactor safety issues regarding the use of MOX fuel in existing LWRs are addressed in a recent report by the NAS. The report indicates that the potential influences on the safety of the use of MOX fuel in LWRs has been extensively studied in the United States in the 1970s. These influences on safety have also been extensively studied in Europe, Japan, and Russia. Regarding effects of MOX on accident probabilities, the report states, "... no important overall adverse impact of MOX use on the accident probabilities of the LWRs 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 that will involve factors not related to fuel composition and hence unaffected by the use of MOX rather than LEU fuel" (NAS 1995a:352). Regarding the effects of MOX on accident consequences, the report states, "... it seems unlikely that the switch from uranium-based fuel could worsen the consequences of a postulated (and very improbable) severe accident in a LWR by more than 10 to 20 percent. The influence on the consequence of less severe accidents, which probably dominate the spectrum value of population exposure per reactor-year of operation would be even smaller, because less severe accidents are unlikely to mobilize any significant quantity of plutonium at all" (NAS 1995a:355).

Analysis described in Appendix M.5 has been performed using the MACCS code to determine the effects of the use of MOX fuel in an existing LWR. The accident assumed conditions including a large population distribution near the existing LWR, and meteorology conditions for dispersal leading to large doses, and would not necessarily be reflective of actual site conditions. A sample of severe accident scenarios is illustrated in Table 4.3.5.2.9–3. The data shown are derived from a range of severe accidents that make up the release scenarios. Some accidents have frequencies much less than 1×10^{-8} /yr and large releases. These low frequency/high release accidents were included to reflect severe accident conditions leading to core damage and release of radioactive materials in order to obtain an estimate on the effects of using MOX fuel versus uranium fuel, as indicated by the ratios. To perform a comparison of existing commercial LWR impacts with other disposition alternatives, reactor accidents with frequencies less than 1×10^{-7} /yr would need to be done with site-specific meteorology, receptor, and population data.

Impacts are calculated in units of probability of cancer fatality for the maximum exposed individual and the worker and the number of cancer fatalities for the offsite population. The fatality data shown does not reflect site conditions and would differ if site-specific meteorology and population were used. The ratios of accident fatalities for MOX and UO_2 fueled LWRs are given in Table 4.3.5.2.9–4 only for the purpose of showing the relative impacts because the ratios would not be affected by meteorological or population data. Each scenario is based on releases taken from an existing commercial LWR probabilistic risk assessment of severe accidents. The releases were modeled using the MACCS code based on a large population distribution near a generic LWR and meteorological conditions for dispersal leading to large doses and would not necessarily be reflective of actual site conditions. Further site-specific NEPA and safety reviews would be performed should the Existing LWR Alternative be selected at the ROD.

Table 4.3.5.2.9-3. Accident Impacts for Existing Light Water Reactor with Mixed Oxide Fuels

Accident Release Scenarios ^a	Worker at 1,000 m				Maximum Offsite Individual				Population Within 80 km			
	Accident Category	Frequency ^b (per year)	Probability of Latent Cancer Fatality	Risk of Latent Cancer Fatality (per 11 yr)	Probability of Latent Cancer Fatality (per year)	Risk of Latent Cancer Fatality (per 11 yr)	Risk of Latent Cancer Fatality (per year)	Risk of Latent Cancer Fatality (per 11 yr)	Number of Latent Cancer Fatalities	Risk of Latent Cancer Fatalities (per year)	Risk of Latent Cancer Fatalities (per 11 yr)	Risk of Latent Cancer Fatalities (per 11 yr)
Steam generator tube rupture	1.5x10 ⁻⁶	1.0	1.5x10 ⁻⁶	2.6x10 ⁻⁵ (1.7x10 ⁻⁵)	1.0	1.5x10 ⁻⁶	2.6x10 ⁻⁵ (1.7x10 ⁻⁵)	2.6x10 ⁻⁵ (1.7x10 ⁻⁵)	5.9x10 ³	0.0089	0.15 (0.098)	0.15 (0.098)
Large late containment failure-high RCS pressure	8.1x10 ⁻⁶	0.79	6.4x10 ⁻⁶	1.1x10 ⁻⁴ (7.2x10 ⁻⁵)	0.86	7.0x10 ⁻⁶	1.2x10 ⁻⁴ (7.8x10 ⁻⁵)	1.2x10 ⁻⁴ (7.8x10 ⁻⁵)	1.3x10 ²	0.0011	0.018 (0.012)	0.018 (0.012)
Large early containment failure-medium/low RCS pressure	7.0x10 ⁻⁷	1.0	7.0x10 ⁻⁷	1.2x10 ⁻⁵ (7.8x10 ⁻⁶)	1.0	7.0x10 ⁻⁷	1.2x10 ⁻⁵ (7.8x10 ⁻⁶)	1.2x10 ⁻⁵ (7.8x10 ⁻⁶)	2.3x10 ³	0.0016	0.027 (0.018)	0.027 (0.018)
Large early containment failure-high RCS pressure	8.7x10 ⁻⁷	1.0	8.7x10 ⁻⁷	1.5x10 ⁻⁵ (9.8x10 ⁻⁶)	1.0	8.7x10 ⁻⁷	1.5x10 ⁻⁵ (9.8x10 ⁻⁶)	1.5x10 ⁻⁵ (9.8x10 ⁻⁶)	1.6x10 ³	0.0014	0.024 (0.016)	0.024 (0.016)
Interfacing system loss of cooling accident	1.3x10 ⁻⁷	1.0	1.3x10 ⁻⁷	2.2x10 ⁻⁶ (1.4x10 ⁻⁶)	1.0	1.3x10 ⁻⁷	2.2x10 ⁻⁶ (1.4x10 ⁻⁶)	2.2x10 ⁻⁶ (1.4x10 ⁻⁶)	7.3x10 ³	0.00095	0.016 (0.010)	0.016 (0.010)
Small early containment failure	2.4x10 ⁻⁶	1.0	2.4x10 ⁻⁶	4.1x10 ⁻⁵ (2.7x10 ⁻⁵)	1.0	2.4x10 ⁻⁶	4.1x10 ⁻⁵ (2.7x10 ⁻⁵)	4.1x10 ⁻⁵ (2.7x10 ⁻⁵)	1.2x10 ³	0.0029	0.049 (0.032)	0.049 (0.032)

^a Each release scenario is based on existing commercial LWR probabilistic risk assessment of severe accidents. The release scenarios were modeled using the MACCS code based on large population distribution near a generic site and meteorological conditions leading to large doses. Therefore, the fatality data shown are not relevant to nor indicative of fatalities that would be calculated if site-specific meteorological and population data were used in the model.

^b A release scenario typically will contain many accident sequences that have a common outcome (for example a steam generator tube rupture). Each accident sequence has a frequency of occurrence that is derived from an event tree analysis and will include sequences with frequencies that are below those used in typical EISs.

^c The population risk of latent cancer fatality, when compared with similar risk from the use of LEU reactor fuel, yields correct latent cancer fatality ratios of MOX-fuel relative to LEU-fuel. The accident conditions include a large population distribution near the existing LWR and meteorology conditions for dispersal leading to large doses and would not necessarily be reflective of actual site conditions. Further site-specific NEPA and safety documentation would be completed if the Existing LWR Alternative is selected.

Note: RCS = Reactor Coolant System. For the Preferred Alternative, for analysis purposes, approximately 70 percent of the Pu was assumed to be used for MOX fuel. The impacts projected for 50 t for the assumed 17-year existing LWR campaign would be proportionately reduced to those for an 11-year campaign; all values are mean values.
Source: HNUUS 1996a.

Table 4.3.5.2.9-4. Ratio of Accident Impacts for Mixed Oxide Fueled and Uranium Fueled Reactors for Typical Severe Accidents (Mixed Oxide Impacts/Uranium Impacts)^a

Accident Release Scenarios^b	Worker at 1,000 m	Maximum Offsite Individual	Population Within 80 km
Steam generator tube rupture	0.94	0.94	0.94
Large late containment failure-high RCS pressure	1.08	1.07	1.08
Large early containment failure-medium/low RCS pressure	0.93	0.93	0.93
Large early containment failure-high RCS pressure	0.97	0.96	0.97
Interfacing system loss of cooling accident	0.93	0.92	0.93
Small early containment failure	0.96	0.95	0.96

^a The ratio of accident fatalities for MOX- and UO₂-fueled LWRs are shown for the purposes of showing relative impacts. For example, 0.94 indicates that the impacts of the accident would be lower for a reactor with MOX fuel.

^b Each release scenario is based on existing commercial LWR probabilistic risk assessment of severe accidents. The release scenarios were modeled using the MACCS code based on large population distribution near a generic site and meteorological conditions for dispersal leading to large doses. Therefore, the fatality data shown are not relevant to nor indicative of fatalities that would be calculated if site-specific meteorological and population data were used in the model.

Note: RCS=Reactor Coolant System.

Source: HNUS 1996a.

4.3.5.2.10 Waste Management

This section summarizes the waste management impacts resulting from the burning of MOX fuel in existing commercial pressurized LWRs. There would be no high-level or TRU wastes associated with the burning of MOX fuel in an LWR. Facilities that would support the existing commercial LWR would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with NRC regulations, RCRA, and other applicable statutes as outlined in section E.1.2.

Operation of the existing commercial light water reactors to include burning of MOX fuel is not expected to increase the amount or change the content of waste generated (ORNL 1995b:B-8). The use of a MOX fuel core results in a somewhat different distribution of fission products. Consequently, the details of radionuclide distribution would be different. However, system modifications are not expected to be needed in order to comply with current regulatory requirements.

Operation of the existing commercial LWR would generate spent nuclear fuel. The MOX fuels designed for serving Pu disposition would not stay in the reactors' cores so as to recover their full economic values. For this analysis it was assumed that the MOX fuel bundles would be removed as soon as the fuel had been irradiated to the point where it had met the Spent Fuel Standard. Therefore the MOX fuel cycle for each refueling would be shorter than the current typical commercial nuclear plant. This assumption was used in order to bound the impacts for spent fuel generation and to dispose of the excess weapons-usable fissile material as quickly as possible. Since the number of assemblies discharged per year for the MOX cycles is greater than that of the average LEU cycle, the amount of wet or dry storage required for the MOX cycles would be more than for the average of the LEU cycles. Data from existing PWR commercial reactors shows that the average number of assemblies discharged annually is 48. Assuming 0.43 t (0.47 tons) per assembly for PWRs, this equates to 21 t (23 tons) of residual heavy metal content. The increase in the number of assemblies discharged annually due to the burning of MOX fuel in a PWR would be approximately 32 assemblies on the average. This would result in an additional 14 t (15 tons) of residual heavy metal. Based on this average, an additional two rail or eight truck shipments of spent fuel would be required annually. The actual incremental increase would depend on the specific reactor selected. Data from existing BWR commercial reactors shows that the average number of assemblies discharged annually is 127. Assuming 0.18 t (0.20 tons) per assembly for BWRs, this equates to 23 t (25 tons) of residual heavy metal content. The increase in the number of assemblies discharged annually due to the burning of MOX fuel in a BWR would be approximately 15 on the average (ORNL 1995b:B-11). This would result in an additional 3 t (3.3 tons) of residual heavy metal annually. Based on this average, an additional one rail or two truck shipments of spent fuel would be required. As noted earlier, the actual incremental increase would depend on the specific reactor selected. The decay heat rate of discharged fuel assemblies initially charged with weapon-grade Pu is within a few percent of current LEU discharged fuel (ORNL 1995b:B-10). Consequently, there would be minimal negative impact on the cooling needed for irradiated fuel element storage due to the substitution of MOX fuel for LEU fuel. Spent nuclear fuel would have to be stored onsite until a Federal geologic repository is available. Spent nuclear fuel would be maintained in the spent fuel storage pool for a minimum of 10 years to allow for sufficient cooling. The annual increase of MOX spent nuclear fuel assemblies could necessitate an increase in the size of the storage pools to accommodate the number of additional assemblies. However, all of the plants considered have sufficient spent fuel pool capacity to accommodate additional assemblies resulting from the use of MOX fuel. Additionally, dry storage onsite would alleviate pool crowding until shipment of the spent fuel to a repository (ORNL 1995b:B-10). There could be design/safety and transportation impacts associated with packaging and shipping the increased volumes of spent nuclear fuel to another offsite location.

4.3.5.3 Partially Completed Light Water Reactor Alternative

The environmental impacts described in the following sections are based on the analysis of the partially completed LWR facility for the Partially Completed LWR Alternative described in Section 2.4.5.3. This alternative would require the operation of a minimum of two LWRs, which could be located at the same or different sites. Environmental impacts for this facility are described in the context of a generic range of conditions that could exist at potential locations.

In accordance with this alternative for surplus Pu disposition, two partially completed LWRs would be needed. The two LWRs could be at one site, or the reactors could be at two sites. If there are two reactors at one site, the impacts in Sections 4.3.5.3.1 through 4.3.5.3.10 would be approximately doubled unless otherwise indicated (for example, direct workers).

4.3.5.3.1 Land Resources

Land Use. Because this is an existing site, direct impacts to land use are not anticipated during completion of construction and during operation. Existing land use would not change; additional land area would not be disturbed for the facility nor required for a buffer zone. Since the reactor facility is partially completed, land use should be in conformance with site development/facility plans for the representative site. Additionally, development should be in conformance with land-use plans, policies, and controls at the Federal, State, and local levels. As discussed in Section 4.3.5.3.8, nonhousing units in excess of existing vacancies would be required to accommodate in-migration that would occur during both the construction and operational phases. No offsite land use would be affected during construction; therefore, indirect impacts would not occur.

Visual Resources. No impacts to visual resources would be caused by completion of the facility. The existing VRM classification would reflect that of a developed industrial facility (Class 5). It is unlikely that visual impacts would be caused by completion of construction. Facility operations could cause an increase in visual impacts to adjacent lands. An increase in visible stack plumes could impact viewpoints with high sensitivity levels including water-based recreational use urbanized areas, residential areas, and public roadways within the viewshed depending on distance, atmospheric conditions, and level of screening provided by vegetation and terrain.

[Text deleted.]

4.3.5.3.2 Site Infrastructure

The site infrastructure of the partially completed LWR would conform to the conditions described in Section 3.12.2. A site infrastructure at the partially completed site is already in place to support completion of the construction project. This includes roads, parking and facilities to accommodate approximately 4,500 site employees. The infrastructure would require only minor upgrades to accommodate the workforce needed to complete the project (see Table 4.3.5.3.2-1). The reactors would be completed essentially as if they were to be fueled with LEU fuel. The change to MOX fuel would have minimal impact on the partially completed LWR and would not affect the site infrastructure. The site is served with water and an existing power distribution system that would adequately support the power demands of plant equipment and employee facilities.

Table 4.3.5.3.2-1. Additional Site Infrastructure Needed for the Operation of the Partially Completed Light Water Reactor (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Railroads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirement	<8	<6	700,000 to 1,100,000	96 to 140	Approximately 757,000	0	0
Range of resource availability	<8	<6	700,000 to 1,100,000	96 to 140	Approximately 757,000	0	0
Amount required in excess of low-end range of available resources	0	0	0	0	0	0	0

Source: LLNL 1996g; TVA 1995b:1.

4.3.5.3.3 *Air Quality and Noise*

Construction and operation of the partially completed LWR facility would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal standards. Impacts for radiological airborne emissions are discussed in Section 4.3.5.3.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Remaining construction and operation of the facility would result in the emission of some pollutants at the representative sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during completion of construction include the following:

- Fugitive dust from wind erosion of exposed ground surfaces
- Exhaust from and road dust raised by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

Appropriate control measures would be followed. It is expected that the site will continue to comply with applicable Federal and State ambient air quality standards during construction.

Emission rates for operation of partially completed LWR are presented in Table F.1.3–13. Air pollutant emissions sources associated with operations include the following:

- Operation of auxiliary steam generators
- Operation of diesel generators and periodic testing of emergency diesel generators
- [Text deleted.]
- Small quantities of toxic/hazardous pollutant emissions from various facility maintenance activities

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal regulations. The estimated pollutant concentrations for operation of this facility are presented in Table 4.3.5.3.3–1.

NOISE

The location of the facilities associated with the partially completed LWR facility relative to the site boundary and sensitive receptors was examined for a partially completed reactor site. The potential contribution to noise levels at the site boundary was evaluated.

Noise sources during completion of construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along major offsite transportation routes used to bring construction material and workers to the site. Noise impacts associated with increased traffic on access routes were not evaluated.

Table 4.3.5.3.3-1. Estimated Incremental Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Partially Completed Reactor

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ^a ($\mu\text{g}/\text{m}^3$)	Representative Site ^b ($\mu\text{g}/\text{m}^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	10,000	<0.01
	1-hour	40,000	<0.01
Lead	Calendar Quarter	1.5	^c
Nitrogen dioxide	Annual	100	0.05
Ozone	1-hour	235	^d
Particulate matter less than or equal to 10 microns in diameter	Annual	50	<0.01
	24-hour	150	0.015
Sulfur dioxide	Annual	80	0.04
	24-hour	365	0.15
	3-hour	1,300	0.35
Hazardous and Other Toxic Compounds^e			
[Text deleted.]			

^a The Federal standards are presented.

^b The concentration represents the alternative contribution only. No Action concentrations at a generic site cannot be determined since there is a range of possible pollutants and conditions that could be found at a potential site.

^c No sources of this pollutant have been identified.

^d Ozone, as a criteria pollutant, is not directly emitted or monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

^e Emissions of unspecified hydrocarbons were not modeled.

Note: Concentrations are based on site contribution and do not include the contribution from nonfacility sources.

Source: 40 CFR 50; TVA 1974b.

Nontraffic noise sources associated with operation of this facility include ventilation systems, cooling systems, circuit breakers, pumps, motors, vents, diesel generators, transformers, paging systems, and material handling equipment. These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would be small (TVA 1974b:2.6-14,8.2-13). Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts, such as disturbance of wildlife.

4.3.5.3.4 Water Resources

Utilizing excess Pu as fuel would have impacts from completion of construction and the operation of a partially completed LWR. Water resources requirements, provided in Table C.1.1.3-7, were used to assess impacts to surface water. The water requirements to complete the construction of both units would be 440 million l/yr (116 million gal/yr). The average water requirement for construction of a single partially completed LWR would be 220 million l/yr (58.1 million gal/yr). Impacts to the river flow would be negligible. [Text deleted.]

During operations, approximately 138,167 million l/yr (36,500 million gal/yr) of water would be required for the operation of both reactors (TVA 1974b:2.9-11). The average water withdrawal from the operation of a single partially completed LWR would be 69,084 million l/yr (18,250 million gal/yr) which is 0.2 percent of the average flow of the river (89 billion l/day [23.5 billion gal/day]). This withdrawal is not anticipated to have any impacts on downstream users. This amount would not curtail known or projected industrial water uses or affect the average flow by the site each day. Operational impacts have been identified in the site-specific EIS that has been prepared for these facilities.

During operations, sanitary wastewater would be discharged at the site. However, at a wet site, unlike water waste effluent from treatment facilities which is released on a continuous basis, cooling system blowdown activities would also occur. The normal blowdown rate from the cooling towers from both reactors would be approximately 2.09 m³/s (74 ft³/s) during periods of high evaporation (TVA 1974b:2.5-1). The average blowdown from the operation of a single partially completed LWR would be 1.05 m³/s (37 ft³/s) which is 0.1 percent of the average flow of the river (1,029 m³/s [36,359 ft³/s]). This blowdown is not anticipated to have any impacts on downstream users. Blowdown will be returned to the river through a diffuser system designed to provide good diffusion and to minimize environmental impacts due to the disturbance of aquatic life during construction and operation of the reactor (TVA 1974b:2.5-1).

Impacts to floodplains from the partially completed LWR (for both construction and operation) were not elevated in the site-specific EIS for the partially completed LWR because although the Bellefont site was used for analyses purposes, specific sites for floodplain analysis are not proposed at this time. If this alternative is selected for further consideration as a method of disposition, site-specific floodplain evaluations would be conducted in future tiered NEPA documents, as appropriate.

4.3.5.3.5 *Geology and Soils*

Effects to the geologic and soil resource as a result of construction and operational activities at a partially completed LWR for the final disposition of Pu are assessed for the representative site.

No direct or indirect effects from restricted access to potential geologic resources as a result of facility or site infrastructure improvements are anticipated because the site is partially completed and no new ground-disturbing construction is anticipated.

Implementation of this alternative would not involve ground-disturbing construction activities that will affect the soil erosion potential. Operational impacts to the soil resource would be minimal assuming typical landscaping and ground cover improvements were employed. Areas previously without ground cover would have some type of improvements (buildings, roads and landscapes). Soil erosion from stormwater runoff and wind action could occasionally occur during operation but are anticipated to be minimal.

4.3.5.3.6 *Biological Resources*

Terrestrial Resources. The assumed representative partially completed reactor site that could be utilized for the disposition of surplus Pu is located within the deciduous forest principal vegetation type. Although numerous construction activities would be required to complete the plant, such activities would generally take place on previously disturbed land. Construction could cause some disturbance to wildlife living immediately adjacent to the facility. During operation of the completed reactor, noise and human presence could continue to discourage some species from living nearby. Depending upon the type of cooling system used, operational impacts to vegetation are possible from salt drift.

Wetlands. Direct impacts to wetlands are unlikely since construction activities would generally take place on previously disturbed land. Indirect impacts from erosion and subsequent sedimentation could occur. However, implementation of a soil erosion and sedimentation control plan would limit such impacts. During operation, wastewater discharges could impact wetlands in the immediate vicinity of the outfall. Also depending upon the type of cooling system used, salt drift from cooling towers could impact wetland areas.

Aquatic Resources. Impacts from construction activities to aquatic species could result from sedimentation of nearby waterbodies. Effective erosion control would prevent damage to aquatic resources.

Operation of the LWR could lead to an increase in the impingement and entrainment of aquatic organisms. The extent to which this would impact local fish populations would be dependent upon the stream size, intake and discharge volumes, intake and discharge structure design, and the susceptibility of individual species to impingement and entrainment. Thermal impacts resulting from the discharge of cooling tower blowdown are possible. Thermal impacts would be controlled by the conditions of an NPDES permit.

Threatened and Endangered Species. Construction activities associated with completion of a reactor are unlikely to impact threatened and endangered species. This is the case since little or no additional habitat would be disturbed. Operational impacts, such as from operation of the cooling system, are possible but depend on the specific species present. Preactivity surveys and consultation with the USFWS and the appropriate State agency would be completed as necessary prior to construction or operation of the reactor.

4.3.5.3.7 *Cultural and Paleontological Resources*

This section discusses impacts to cultural and paleontological resources that may result from the construction and operation of a partially completed LWR. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Prehistoric resources that may occur in the vicinity of the partially completed LWR include remains of villages, cemeteries, and hunting and butchering sites. Historic sites may include cemeteries, remains of residential or commercial structures, or road traces. It is possible but unlikely that resources may be affected by the completion of the facility. Operation would not cause additional effects. Some Native American resources such as archaeological sites or traditional use areas may also occur in the areas.

No paleontological resources have been identified in the vicinity of the partially completed LWR. Cultural and paleontological resources may be affected directly through ground disturbance during construction, building modification, visual intrusion of the project into the historic setting or environmental context of historic sites, visual and audio intrusions into Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism. Minor modifications to existing facilities would be necessary under this alternative. Some infrastructure improvements may also be necessary. Specific concerns about the presence, type, and location of Native American resources would be addressed through consultation with the potentially affected Native American tribes.

4.3.5.3.8 Socioeconomics

Regional Economy Characteristics. Finishing the construction of the partially completed reactor would generate employment and income increases within the affected region. Facility construction would create 2,848 total jobs (1,525 direct and 1,323 indirect) for one reactor and 4,305 (2,305 direct and 2,000 indirect) for two. However, total employment and per capita income in the representative site's REA would increase by less than 1 percent under either scenario. Operation of one reactor would generate about 2,200 total jobs in the REA (847 direct and 1,353 indirect) and 3,311 total jobs (1,275 direct and 2,036 indirect) would be created with the operation of two reactors. Operation of one or two reactors would increase employment in the REA by less than 1 percent over No Action projections. The unemployment rate would decrease slightly and there would be small increases in per capita income (Socio 1996a). Only the Two-Reactor Option is analyzed for population, housing, and community service because it would have a greater impact on the region.

Population and Housing. The resident labor force would not be sufficient to fill all of the newly created jobs during the construction and operation phases of the project. In-migrating workers and their families would increase population in the ROI during both phases of the project. About 180 construction-related workers would in-migrate, and population would increase by much less than 1 percent over to No Action population projections. During operation of the facility, approximately 300 workers would in-migrate to the ROI. Population growth would be less than 1 percent over No Action projections. No housing units, in excess of existing vacancies, would be required in the ROI during construction and operation of the project (Socio 1996a).

Community Services. Constructing and operating the partially completed LWR would slightly increase the demand for community services at the representative site.

School enrollments would increase in the representative ROI during construction and operation of the facility. To maintain the No Action student-to-teacher ratio of 15.5:1, two new teachers would be needed during peak construction of the two-reactor facility, and eight additional teachers would be needed during operation. The increase in teacher requirements would be distributed over several school districts in the ROI; therefore, no single school district would be significantly affected (Socio 1996a).

Only 1 additional police officer would be needed during both the construction and operation phases of the two-reactor facility to maintain the No Action service level of 1.5 officers per 1,000 persons in the representative site's ROI. One new firefighter would be needed during construction, and only 3 new firefighters would be needed during operation to maintain the current service level of 4.1 firefighters per 1,000 persons (Socio 1996a).

Projected hospital occupancy rates during peak construction and full operation would increase slightly over No Action levels, with existing hospital capacities capable of accommodating the small increase in patient load. No additional physicians would be needed during construction, and only one new physician will be needed during operation of the two-reactor facility (Socio 1996a).

Local Transportation. The two-reactor option's construction and operation may cause a decline in the level of service on some roads around the representative site. Some road improvements may be required (Socio 1996a).

4.3.5.3.9 Public and Occupational Health and Safety

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal performance or accidents involved with the operation of an LWR that is presently only partially completed. The section first describes the impacts from normal facility operation followed by a description of impacts from reactor accidents. The impacts associated with the ultimate disposal of the spent fuel in a high level waste repository are presented separately in technical documents that specifically address repository operations.

Summaries of the radiological impacts to the public and to workers associated with normal operation during the assumed 17-year campaign time are presented in Tables 4.3.5.3.9-1 and 4.3.5.3.9-2, respectively. Detailed results are presented in Appendix M.

Normal Operation. There would be no radiological releases associated with the construction needed to complete the reactor. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as the result of construction activities. However, concentrations would be within the regulated exposure limits.

During normal reactor operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the reactor and its support facilities are presented in Table 4.3.5.3.9-1. Since there are no other nuclear activities at the site, the impacts from total site operations would be the same as the reactor facility impacts. The doses to the maximally exposed member of the public from annual operations are within the radiological limits specified in Appendix I to 10 CFR 50 and 40 CFR 190 (if the reactor is licensed by NRC). The dose would be 0.57 mrem from all pathways. From 17 years of operation, the associated risk of fatal cancer to this individual would be 4.9×10^{-6} . The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are ALARA. As a result of annual total site operation, the population dose would be 0.61 person-rem and the number of fatal cancers in the population from 17 years of operation would be 5.2×10^{-3} . To put the operational doses into perspective, comparisons with doses from natural background radiation are included in the table.

Doses to onsite workers from normal operations are given in Table 4.3.5.3.9-2. The annual average dose to the site worker would be 360 mrem. The dose to the entire workforce would be 380 person-rem. The risk and number of fatal cancers among the workers from 17 years of operation are included in Table 4.3.5.3.9-2.

Hazardous Chemical Impacts. There would be no increase in the potential hazardous impact to the public and workers from construction of the partially completed LWRs. The potential impacts of chemical emissions from operation would be as stated in the Bellefonte Final EIS dated May 1974. The source of chemicals and chemical quantities were reviewed and updated in connection with the renewal of the NPDES permit in 1992 (TVA 1993a:7). The computations and assumptions used for this review were consistent with those in this PEIS and potential impacts are still expected to be insignificant. This is confirmed by voluntary toxicant testing which is conducted on a semiannual basis. The *Letter Report FMDP LWR PEIS Data Report* (ORNL/MD/LTR-9, February 28, 1995) indicates that if a change were made from burning uranium-based fuel to burning MOX fuel in an LWR, the nonradiological chemical emissions would not change. Therefore the potential health impacts to the public and workers from hazardous chemicals emitted from the partially completed LWRs alternative facility would not change from the LWRs using UO_2 fuels.

Table 4.3.5.3.9–1. Potential Radiological Impacts to the Public During Normal Operation of the Partially Completed Light Water Reactor

Receptor	Generic Site	
	Reactor	Total Site ^a
Annual Dose to the Maximally Exposed Individual Member of the Public^b		
Atmospheric release pathway (mrem)	0.56	0.56
Drinking water pathway (mrem)	1.4×10^{-3}	1.4×10^{-3}
Total liquid release pathway (mrem)	5.4×10^{-3}	5.4×10^{-3}
Atmospheric and liquid release pathways combined (mrem)	0.57	0.57
Percent of natural background ^c	0.19	0.19
17-year fatal cancer risk	4.9×10^{-6}	4.9×10^{-6}
Annual Population Dose Within 80 Kilometers		
Atmospheric release pathway (person-rem)	0.47	0.47
Total liquid release pathway (person-rem)	0.14	0.14
Atmospheric and liquid release pathways combined (person-rem)	0.61	0.61
Percent of natural background ^c	1.6×10^{-4}	1.6×10^{-4}
17-year fatal cancer risk	5.2×10^{-3}	5.2×10^{-3}
Annual Dose to the Average Individual Within 80 Kilometers^d		
Atmospheric and liquid release pathways combined (mrem)	4.5×10^{-4}	4.5×10^{-4}
17-year fatal cancer risk	3.8×10^{-9}	3.8×10^{-9}

^a Since there are no other nuclear activities at the site, the total site impacts are the same as the incremental impacts.

^b The standards for individual members of the public are given in Appendix I to 10 CFR 50 and 40 CFR 190 for NRC licensed reactors. As discussed in Appendix I, 5 mrem/yr is the airborne emission guideline and 3 mrem/yr per reactor is the liquid release guideline. Meeting these guideline values serves as a numerical demonstration that doses are ALARA. A total dose of 25 mrem/yr is the limit from all pathways combined, as given in 40 CFR 190. If the reactor is owned by DOE, the applicable radiological limits for an individual member of the public from total site operations are 10 mrem per year from the air pathways as required by NESHAPS (40 CFR 61, Subpart H) under the CAA, 4 mrem per year from the drinking water pathway as required by the SDWA, and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

^c Annual natural background radiation levels: the average individual receives 298 mrem; the population within 80 km receives 407,000 person-rem.

[Text deleted.]

^d Obtained by dividing the population dose by the number of people projected to be living within 80 km of the site (1,365,000). Source: Section M.2.

Table 4.3.5.3.9–2. Potential Radiological Impacts to Workers During Normal Operation of the Partially Completed Light Water Reactor

Receptor	Generic Site
Involved workforce^a	
Average worker dose (mrem/yr) ^b	360
17-year risk of fatal cancer	2.4×10^{-3}
Total dose (person-rem/yr)	380
17-year fatal cancers	2.6

^a An involved worker is a worker associated with operations of the proposed action.

^b The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 20).

[Text deleted.]

Source: NRC 1995b; ORNL 1995b.

Facility Accidents. For the partially completed commercial LWR, a Preliminary Safety Analysis Report (PSAR) has been prepared for the representative reactor in accordance with NRC Requirements. The PSAR does not reflect the potential effects on public and worker safety of using MOX fuel. An analysis, described in Section M.5, has been performed which indicates that the use of MOX fuel in a commercial LWR would have small effects. This can be seen from the information provided in Tables 4.3.5.2.9-3 and 4.3.5.2.9-4. For each of the three reactor cases of severe accidents listed, the MACCS code was run for the severe accidents identified based on a uranium-fueled core and a MOX-fueled core. Although the sets of severe accidents are not specifically for the partially completed reactors applicable to this alternative, the results of the MACCS code analysis are considered relevant. Each entry in the table is the ratio of impacts of severe accidents for a MOX-fueled reactor and a uranium-fueled reactor. The results indicate that the use of MOX fuel in place of uranium fuel in a LWR would have an effect on accident impacts ranging from an 8-percent decrease to an 8-percent increase depending on the accident that occurs.

4.3.5.3.10 Waste Management

This section summarizes the waste management impacts for the construction and operation resulting from the burning of MOX fuel in a partially completed commercial LWR. There is no high-level or TRU waste associated with the burning of MOX fuel in a LWR. Table 4.3.5.3.10-1 provides the total estimated operational waste volumes projected to be generated per reactor for burning MOX fuel in a partially completed commercial LWR. Waste generation volumes under No Action are from maintenance activities and the limited engineering design work. Facilities that would support the partially completed commercial LWR would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with NRC regulations, RCRA, and other applicable statutes as outlined in Section E.1.2.

Construction and operation of the partially completed commercial LWR would impact existing waste management activities at the site, by initiating the generation of spent nuclear fuel, LLW, and mixed LLW, and increasing the generation of hazardous and nonhazardous wastes. Wastes generated during construction would consist of wastewater and hazardous, low-level, and nonhazardous solid wastes. A small amount of solid LLW, 0.5 m^3 (0.7 yd^3) composed mainly of radioactive sources, would be generated during construction. Inert construction and demolition wastes ranging from 211 m^3 (276 yd^3) to 392 m^3 (513 yd^3) for concrete; 88 t (97 tons) to 208 t (229 tons) for steel; and $21,000 \text{ m}^3$ ($27,500 \text{ yd}^3$) to $49,000 \text{ m}^3$ ($64,100 \text{ yd}^3$) for block, brick, gravel, asphalt, gypsum board, and other materials, would be placed in dumpsters for disposal by the solid waste disposal contractor at an offsite permitted landfill or recycled if appropriate. Construction sanitary wastewater from the main plant (based on data from similar plants) range from $127,000 \text{ m}^3$ ($33,500,000 \text{ gal}$) to $274,600 \text{ m}^3$ ($72,500,000 \text{ gal}$) and would be routed to the local municipal sewage treatment system. Typical hazardous waste generated during construction of a partially completed reactor site (based on data from a similar plant) include paints, solvents, acids, oils, radiographic wastes and degreasers, and range from 3.4 t (3.7 tons) to 6.3 t (6.9 tons) for solid hazardous wastes and 30.6 m^3 ($8,080 \text{ gal}$) to 56.7 m^3 ($15,000 \text{ gal}$) for liquid hazardous wastes. The only waste treatment performed for construction waste onsite would be neutralization of acids. Hazardous wastes would be shipped to commercial RCRA-permitted treatment and disposal facilities (TVA 1995b:1).

Operation of the partially completed commercial LWR would generate spent nuclear fuel. The MOX fuels designed for serving Pu disposition would not stay in the reactors' cores for recovering their full economic values. For this analysis it was assumed that the MOX fuel bundles would be removed as soon as the fuel has been irradiated to the point where it had met the Spent Fuel Standard. Therefore the MOX fuel cycle for each refueling would be shorter than the original design. This assumption was used in order to bound the impacts for spent fuel generation and storage plus it would dispose of the excess weapons-usable fissile material as quickly as possible. Spent nuclear fuel would have to be stored onsite until a Federal geologic repository is available. Data from existing PWR commercial reactors of the same size show that the number of assemblies discharged annually could range from 50.7 to 108.5 (an average of 80 assemblies). Assuming 0.43 t (0.47 tons) per fuel assembly, the residual heavy metal content would range from 22 t (24 tons) to 47 t (52 tons). The original onsite design capacity/availability of pool storage, or above-ground dry storage could be challenged due to the shorter fuel cycle.

Liquid LLW would be treated in an onsite radwaste treatment facility. Compactible solid LLW would either be taken offsite or remain onsite for volume reduction, prior to disposal. For disposal, all LLW would be transported in a solid form. Based on data from 8 existing PWR plants, a range of from 57 m^3 (75 yd^3) to 637 m^3 (833 yd^3) of LLW would be shipped offsite for disposal, as frequently as from 6 to 31 times each year. Assuming the LLW would be transported to a site within the DOE complex for disposal, land usage factors may vary from $3,300 \text{ m}^3/\text{ha}$ ($1,700 \text{ yd}^3/\text{acre}$) to $8,600 \text{ m}^3/\text{ha}$ ($4,500 \text{ yd}^3/\text{acre}$). Consequently, this would require a range of 0.01 ha/yr (0.03 acres/yr) to 0.07 ha/yr (0.2 acres/yr) of LLW disposal area. If the LLW is taken to a NRC or State disposal site, transportation impacts and land usage LLW disposal factors would vary according to the disposal site.

Table 4.3.5.3.10-1. Estimated Annual Waste Volumes Generated Per Reactor for Mixed Oxide Fuel in Partially Completed Light Water Reactors

Category	With MOX Fuel (m ³)	No Action (m ³)
Spent Nuclear Fuel	50.7 to 108.5 ^a assemblies	None
Low-Level		
Liquid	18,930 ^b	None
Solid	57 - 637	None
Mixed Low-Level		
Liquid	0	None
Solid	102	None
Hazardous		
Liquid	Included in solid	Included in solid
Solid	27	2
Nonhazardous (Sanitary)		
Liquid	341,000	3,780 ^c
Solid	5,280	51 ^d
Nonhazardous (Other)		
Liquid	Included in sanitary	None
Solid	4,430 ^e	1.8-3.6 ^f

^a Residual heavy metal content of 22 to 47 t, assuming 0.43 t per assembly for PWR.

^b Liquid LLW would be treated and solidified prior to disposal.

^c Estimate based on 80 employees, 189 l/day/employee and 250 days per year of operations.

^d Estimate based on 80 employees, 0.0085 m³/day/employee and 250 days per year of operations.

^e Recyclable wastes.

^f One to two tons of desiccants. Estimate based on density at 500 kg/m³.

Source: DOE 1995f; ORNL 1995b; TVA 1995b:2.

Approximately 102 m³ (133 yd³) of mixed LLW, consisting primarily of decontamination wastes and ion exchange resins, would be stored onsite until treatment and disposal is available at an offsite RCRA-permitted facility, or shipped to another facility in the DOE complex for treatment and disposal; in accordance with their site treatment plan that was developed pursuant to the requirements of the *Federal Facility Compliance Act*. Hazardous and nonhazardous waste would be managed in accordance with site practice.

4.3.5.4 Evolutionary Light Water Reactor Alternative

The environmental impacts described in the following sections are based on the analysis of the evolutionary LWR facility for the Evolutionary LWR Alternative as described in Section 2.4.5.4. This alternative would require the operation of two to four LWRs, which could be located at the same or different sites. The representative sites used for this facility are: Hanford, NTS, INEL, Pantex, ORR, and SRS. Multiple reactors could be located at a site, or multiple sites could have one reactor. If there are multiple reactors at a site than the total reactor impacts would be approximately the impacts in Section 4.3.5.4.1 through 4.3.5.4.10 times the number of reactors at the site (for example, land use or direct workers).

4.3.5.4.1 Land Resources

This section describes the impacts of constructing and operating the evolutionary LWR. The evolutionary LWR could be constructed in either a large or small reactor option. During construction, 284 ha (700 acres) of land would be disturbed for a two-unit large or small evolutionary LWR. A one-unit large or small evolutionary LWR would disturb 142 ha (350 acres) of land during construction. Total land area requirements during operation for the large or small two-unit evolutionary LWR would be 138 ha (340 acres). Increasing the facility to four units (small reactor option) would increase the operation land area requirement to 227 ha (560 acres). Buffer zones would be established in accordance with applicable NRC regulations. Land-use impacts would be similar for the two-unit large or small reactor options, however, visual impacts for the two-unit large reactor option could be greater because the increased magnitude and extent of site development. Land resources impacts from the four-unit facility would be anticipated to be greater than either of the two-unit options.

Construction and operation of the evolutionary LWR would not cause indirect land-use impacts at the analysis sites. As discussed in Section 4.3.5.4.8, in-migration of workers would be required during both the construction and operational phases. Historic housing construction rates indicate there would be sufficient housing units available to accommodate in-migrating population at each site. Therefore, offsite land use would not be affected.

Hanford Site

Land Use. Vacant land adjacent to the site of the 65-percent complete WNP-1 reactor and the operating WNP-2 reactor on the WPPSS lease would be the potential location for the evolutionary LWR. Operation of the facility would be consistent with existing and proposed land uses pursuant to the current *Hanford Site Development Plan*, which designates this area for reactor operations (HF DOE 1993c:13,14). Therefore, direct impacts to land use would not occur.

The alternative would not affect other Hanford or offsite land uses. No prime farmlands exist onsite. Construction and operation would be consistent with State and local (Benton, Franklin, and Grant Counties and the City of Richland) land-use plans, policies, and controls since Hanford provides information to these jurisdictions for use in their efforts to comply with GMA (HF DOE 1993c:17).

Visual Resources. [Text deleted.] Construction and operation of the evolutionary LWR would be compatible with the industrial landscape character and VRM Class 5 designation of the existing WNP reactor area. A potential visual impact during operations would be from the additional stack plumes. However, due to the existing reactor activities, the visual impact would not occur.

Nevada Test Site

Land Use. A potential location for the evolutionary LWR would be on undeveloped land in Area 6 adjacent to the DAF. Construction and operation of the facility in Area 6 would not be in conformance with the current *Nevada Test Site Development Plan*, which designates the southeast area of NTS as a nonnuclear test area.

However, Area 6 is a potential site for long-term storage and disposition of weapons-usable fissile materials as part of the NTS defense program material disposition activities considered under the Expanded Use Alternative (part of the Preferred Alternative) of the NTS EIS (NT DOE 1996c:3-8, 3-9; NT DOE 1996e:4-18). [Text deleted.]

Construction and operation would not affect other NTS or offsite land uses. No prime farmlands exist onsite. The alternative would not be in conflict with land-use plans, policies, and controls of adjacent jurisdictions since none of the counties or municipalities currently undertakes land-use planning.

Visual Resources. [Text deleted.] Construction and operation of the facility would be compatible with the industrial landscape character of the adjacent DAF and the current VRM Class 5 designation of Area 6. [Text deleted.] Views of the proposed action would be blocked from sensitive viewpoints accessible to the public by mountains terrain.

Idaho National Engineering Laboratory

Land Use. The proposed evolutionary LWR would be located on undeveloped land northwest of the Power Burst Facility (PBF) in the central core area/Prime Development Land Zone of INEL (IN DOE 1992g:12). This zone designation applies to land most suitable for development due to an absence of physical constraints and because of the land's proximity to site infrastructure. [Text deleted.]

Construction would not affect other INEL or offsite land uses. No prime farmlands exist onsite. Construction and operation would not be in conflict with the land-use plans, policies, and controls of adjacent counties and the city of Idaho Falls since they do not address the potential site.

Visual Resources. [Text deleted.] Construction and operations, including the additional stack plumes, would be compatible with the existing visual character of the Prime Development Land Zone. The proposal would be consistent with the existing VRM Class 5 classification.

Pantex Plant

Land Use. The evolutionary LWR would be located on land in agricultural use in the northwest portion of Pantex, west of the Burning Ground and Zone 5. Construction of the evolutionary LWR would change current agricultural land use. A service agreement allows Texas Tech University to use any DOE land for agricultural use if it is not being used for defense purposes. The DOE-owned acreage used for agricultural purposes is variable and subject to periodic changes; therefore, no impact would be anticipated (PX DOE 1995i:2-5). The master plan of the current *Pantex Site Development Plan* designates this area for tritium production (PX DOE 1995g:16). Tritium production is no longer an option at Pantex. However, Pantex could revise the site development plan should Pantex be selected for this alternative.

Construction would not affect other Pantex or offsite land uses. There would be no impacts to prime farmland. The alternative would not be in conflict with City of Amarillo land-use plans, policies, and controls since they do not address Pantex.

Visual Resources. Construction and operation could cause potential impacts, including additional stack plumes. The current VRM Class 4 designation of proposed site would change to Class 5.

Oak Ridge Reservation

Land Use. [Text deleted] The evolutionary LWR is proposed to be located on undeveloped land south of Bear Creek Road along the Clinch River. The potential site is not within the ORR boundary, but it is owned by the TVA. An agreement between DOE and TVA has reserved the site for a nuclear application and it is anticipated

that the land area would be transferred from TVA to DOE. Nonetheless, the future land-use plan of the current *ORR Site Development and Facilities Utilization Plan* designates the site as a major waste management area (OR DOE 1991f:1-7). The site development plan could be revised in accordance with the proposal. The proposed action would be in compliance if this change is approved. However, ownership of the potential site could be a potential impact.

Construction would not affect other ORR land uses. No prime farmlands exist onsite. The evolutionary LWR would not be in conflict with the City of Oak Ridge land-use plans, policies, and controls since the *Oak Ridge Area Land Use Plan* designates the potential site for Industrial and Public land use. Offsite land use would not be affected.

Visual Resources. [Text deleted.] Construction and operation activities would change the current VRM classification of the potential site from Class 3 to Class 5. Visual impacts would occur to Watts Bar Lake, Clinch River, and low density residential development on the opposite side of the Clinch River. Additionally, stack plumes could be visible from I-40, a public roadway with a high sensitivity level. Visual impact would not occur to Clark Center Recreational Park and other public/quasi-public lands (cemeteries and water treatment facilities), forest management area, Melton Hill Lake, and Clinch River Bluffs because of viewing distance, hilly terrain, and forested areas.

Savannah River Site

Land Use. The evolutionary LWR would be located northeast of the N-Area on land presently forested/undeveloped. Facility construction would be in conformance with existing and future land use as designated by the current *Savannah River Site Development Plan*. According to the plan, the future land-use category for the proposed site is primary industrial mission (SR DOE 1994d:11,12). [Text deleted.]

Construction would not affect other SRS or offsite land uses. There is no prime farmland on SRS. Construction would not be in conflict with the land-use plans, policies, and controls of adjacent counties and cities since they do not address SRS.

Visual Resources. Potential impacts to visual resources including additional stack plumes would be anticipated. The current VRM Class 4 designation of the proposed site would change to Class 5. However, views from State Highway 125 and U.S. Highway 278 would be blocked by heavy vegetation, forested cover, and hilly terrain.

[Text deleted.]

4.3.5.4.2 Site Infrastructure

The representative evolutionary LWR sites would require an infrastructure similar to that described in Section 2.4.5.4 for large or small evolutionary LWRs. The length of the Pu disposition campaign and reactor capacities will determine the number of reactors required. At a specific site, existing infrastructure such as roads, railroads, and power line rights-of-way would determine additional requirements for connectivity. Site characteristics such as the availability of water and its bearing on reactor cooling, would also affect site infrastructure.

Changes to the existing infrastructure at representative sites due to the construction and operation of an evolutionary LWR are presented in Tables 4.3.5.4.2-1, 4.3.5.4.2-2, and 4.3.5.4.2-3. The site infrastructure changes associated with locating a single large or small evolutionary LWR at a DOE site follow.

Hanford Site

Electrical, fuel, and water requirements for construction would represent a small percentage of site usage. Transmission lines would be constructed and upgraded for the increased and redistributed electrical load. Additional primary and secondary access roads as well as railroad right-of-way would be required. The requirements can be accommodated with minimal site impact over the 6-year construction period. Operational electrical requirements increase significantly, but are within the capacity of the sub-regional power pool. New and upgraded transmission lines would be put in place for the increased and redistributed electrical load as part of the construction phase. Fuel requirements would not exceed current site availability. Required primary and secondary access roads and railroad right-of-way would be available. Facility requirements can be accommodated without significant site impact.

Nevada Test Site

Electrical requirements for construction would double the projected site usage. Transmission lines would be constructed and upgraded for the increased and redistributed electrical load. Increased fuel requirements can be easily met. Additional fuel required for construction could easily be obtained through contractual means. Additional primary and secondary access roads would also be required. The shipment of large and outsize components would pose a significant problem because of the lack of railroad service. Construction requirements, unique in some cases, can be accommodated over the 6-year construction period. Operational electrical requirements increase significantly over site availability, but are within the capacity of the sub-regional power pool. New and upgraded transmission lines would be put in place for the increased and redistributed electrical load as part of the construction phase. Fuel oil requirements would exceed current site availability, but can be accommodated through normal contractual means. Required primary and secondary access roads would be available. There would not be railroad service available.

Idaho National Engineering Laboratory

Electrical requirements for construction would not exceed site availability. [Text deleted.] Additional primary and secondary access roads as well as railroad right-of-way would be required. These requirements can be accommodated with moderate site impact over the 6-year construction period. Operational electrical requirements increase over site availability, but are within the capacity of the sub-regional power pool. New and upgraded transmission lines would be put in place for the increased and redistributed electrical load as part of the construction phase. Required primary and secondary access roads and railroad rights-of-way would be available.

Table 4.3.5.4.2-1. Additional Site Infrastructure Needed for the Construction of the Large or Small Evolutionary Light Water Reactor (Annual)

	Electrical		Fuel		
	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirements	20,000	20	946,000	0	0
Hanford Site					
Site availability	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	365,500	78	10,280,800	21,039,531	0
Amount required in excess to site availability	0	0	0	0	0
Nevada Test Site					
Site availability	176,844	45	5,716,000	0	0
Projected usage without facility	124,940	25	5,716,000	0	0
Projected usage with facility	144,940	45	6,662,000	0	0
Amount required in excess to site availability	0	0	946,000 ^a	0	0
Idaho National Engineering Laboratory					
Site availability	394,200	124	16,000,000	0	11,340
Projected usage without facility	232,500	42	5,820,000	0	11,340
Projected usage with facility	252,500	62	6,776,000	0	11,340
Amount required in excess to site availability	0	0	0	0	0
Pantex Plant					
Site availability	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	46,266	10	795,166	7,200,000	0
Projected usage with facility	66,266	30	1,741,166	7,200,000	0
Amount required in excess to site availability	0	7	0	0	0
Oak Ridge Reservation					
Site availability	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	746,000	130	1,325,000	95,000,000	16,300
Amount required in excess to site availability	0	0	909,000 ^a	0	0
Savannah River Site					
Site availability	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	794,000	116	28,390,500	0	221,352
Projected usage with facility	814,000	136	29,336,500	0	221,352
Amount required in excess to site availability	0	0	946,000 ^a	0	0

^a Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996g; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

**Table 4.3.5.4.2-2. Additional Site Infrastructure Needed for the Operation of
the Large Evolutionary Light Water Reactor (Annual)**

	Transportation		Electrical		Fuel		
	Roads (km)	Rail- roads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirements	< 5	< 5	1,100,000	140	757,000	0	0
Hanford Site							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	420	204	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	425	209	1,445,500	198	10,091,800	21,039,531	0
Amount required in excess to site availability	< 5	< 5	0	0	0	0	0
Nevada Test Site							
Site availability	1,100 ^a	0	176,844	45	5,716,000	0	0
Projected usage without facility	645	0	124,940	25	5,716,000	0	0
Projected usage with facility	650	0	1,224,940	165	6,473,000	0	0
Amount required in excess to site availability	<5	0	1,048,096	120	757,000 ^b	0	0
Idaho National Engineering Laboratory							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage without facility	445	48	232,500	42	5,820,000	0	11,340
Projected usage with facility	450	53	1,332,500	182	6,577,000	0	11,340
Amount required in excess to site availability	< 5	< 5	938,300	58	0	0	0
Pantex Plant							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	76	27	46,266	10	795,166	7,200,000	0
Projected usage with facility	81	32	1,146,266	150	1,552,166	7,200,000	0
Amount required in excess to site availability	< 5	< 5	944,786	127	0	0	0
Oak Ridge Reservation							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,300
Projected usage without facility	71	27	726,000	110	379,000	95,000,000	16,300
Projected usage with facility	76	32	1,826,000	250	1,136,000	95,000,000	16,300
Amount required in excess to site availability	< 5	< 5	0	0	720,000 ^b	0	0
Savannah River Site							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	230	103	794,000	116	28,390,500	0	221,352
Projected usage with facility	235	108	1,894,000	256	29,147,500	0	221,352
Amount required in excess to site availability	< 5	< 5	222,000	0	757,000 ^b	0	0

^a Includes paved and unpaved roads.

^b Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996g; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Table 4.3.5.4.2-3. Additional Site Infrastructure Needed for the Operation of the Small Evolutionary Light Water Reactor (Annual)

	Transportation		Electrical		Fuel		
	Roads (km)	Rail- roads (km)	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m ³ /yr)	Coal (t/yr)
Facility Requirements	< 5	< 5	580,000	75	416,000	0	0
Hanford Site							
Site availability	420	204	1,678,700	281	14,775,000	21,039,531	91,708
Projected usage without facility	420	204	345,500	58	9,334,800	21,039,531	0
Projected usage with facility	425	209	925,500	133	9,750,800	21,039,531	0
Amount required in excess to site availability	< 5	< 5	0	0	0	0	0
Nevada Test Site							
Site availability	1,100 ^a	0	176,844	45	5,716,000	0	0
Projected usage without facility	645	0	124,940	25	5,716,000	0	0
Projected usage with facility	650	0	704,940	100	6,132,000	0	0
Amount required in excess to site availability	0	0	528,096	55	416,000 ^b	0	0
Idaho National Engineering Laboratory							
Site availability	445	48	394,200	124	16,000,000	0	11,340
Projected usage without facility	445	48	232,500	42	5,820,000	0	11,340
Projected usage with facility	450	53	812,500	117	6,236,000	0	11,340
Amount required in excess to site availability	< 5	< 5	418,300	0	0	0	0
Pantex Plant							
Site availability	76	27	201,480	23	1,775,720	289,000,000	0
Projected usage without facility	76	27	46,266	10	795,166	7,200,000	0
Projected usage with facility	81	32	626,266	85	1,211,166	7,200,000	0
Amount required in excess to site availability	< 5	< 5	424,786	62	0	0	0
Oak Ridge Reservation							
Site availability	71	27	13,880,000	2,100	416,000	250,760,000	16,330
Projected usage without facility	71	27	726,000	110	379,000	95,000,000	16,330
Projected usage with facility	76	32	1,306,000	185	795,000	95,000,000	16,330
Amount required in excess to site availability	< 5	< 5	0	0	379,000 ^b	0	0
Savannah River Site							
Site availability	230	103	1,672,000	330	28,390,500	0	244,000
Projected usage without facility	230	103	794,000	116	28,390,500	0	221,352
Projected usage with facility	235	108	1,374,000	191	28,806,500	0	221,352
Amount required in excess to site availability	< 5	< 5	0	0	416,000 ^b	0	0

^a Includes paved and unpaved roads.

^b Fuel oil requirements in excess to site availability could be procured through normal contractual means.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996g; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

Pantex Plant

Electrical requirements for construction would require transmission lines to be constructed and upgraded for the increased and redistributed electrical load. Additional primary and secondary access roads as well as railroad right-of-way would be needed. These requirements can be accommodated with minimal site impact over the 6-year construction period. Electrical requirements for operations increase over site availability, but are within the capacity of the sub-regional power pool. New and upgraded transmission lines would be put in place for the increased and redistributed electrical load as part of the construction phase. [Text deleted.] Required primary and secondary access roads and railroad right-of-way would be available.

Oak Ridge Reservation

[Text deleted.] Additional oil would be required during the period of construction and during operations. Since oil availability is governed by usage and not by storage capacity onsite, the additional oil required could be procured through normal contracts or the construction companies could provide for this additional oil from local suppliers from construction use. Required primary and secondary access roads and railroad rights-of-way would be available.

Savannah River Site

Fuel oil requirements for construction would represent a small percentage of site usage. [Text deleted.] Additional primary and secondary access roads as well as railroad rights-of-way would be required. These added requirements can be accommodated with minimal site impact over the 6-year construction period. Electrical requirements for large LWR, but not small LWR, operations would increase over site availability, but are within the capacity of the sub-regional power pool. New and upgraded transmission lines would be put in place for the increased and redistributed electrical load as part of the construction phase. Fuel oil requirements would exceed current site availability, but can be accommodated through normal contractual means. Required primary and secondary access roads and railroad rights-of-way would be available. Facility requirements could be accommodated without site impact.

4.3.5.4.3 Air Quality and Noise

Construction and operation of an evolutionary LWR would generate criteria and toxic/hazardous pollutants. To evaluate the air quality impacts, criteria and toxic/hazardous concentrations from this facility have been compared with Federal and State standards and guidelines for each site. Impacts for radiological airborne emissions are discussed in Section 4.3.5.4.9.

Noise impacts during either construction or operation are expected to be low. Air quality and noise impacts are described separately. Supporting data for the air quality and noise analysis are presented in Appendix F.

AIR QUALITY

Construction and operation of the facility would result in the emission of some pollutants at each of the sites. Emissions would typically not exceed Federal, State, or local air quality regulations or guidelines.

The principal sources of emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and possible operation of a concrete batch plant
- Exhaust and road dust generated by construction equipment, vehicles delivering construction materials, and vehicles carrying construction workers

The PM₁₀ and TSP concentrations are expected to increase during the peak construction period. Appropriate control measures would be followed. It is expected that the sites will continue to comply with applicable Federal and State ambient air quality standards during construction.

Emission rates for operation of the evolutionary LWR are presented in Table F.1.3–14. Air pollutant emissions sources associated with operations include the following:

- Operation of diesel generators and periodic testing of emergency diesel generators
- [Text deleted.]
- Small quantities of toxic/hazardous pollutant emissions from facility operations

During operation, concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, State, and local air quality regulations or guidelines. The estimated pollutant concentrations from reactor operations plus the No Action concentrations are presented in Table 4.3.5.4.3–1. There are no toxic/hazardous chemical emissions associated with this facility.

NOISE

The location of the facilities associated with the evolutionary LWR facility relative to the site boundary and sensitive receptors was examined for each site to evaluate the potential contribution to noise levels at these locations and the potential for onsite and offsite noise impacts. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Nontraffic noise sources associated with operation of these facilities include ventilation systems, cooling systems, vents, pumps, motors, emergency diesel generators, transformers, paging systems, and material

Table 4.3.5.4.3-1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Evolutionary Light Water Reactor and No Action Alternative

Pollutant	Criteria	Averaging Time	Most Stringent Regulations or Guidelines ^a (µg/m ³)	Hanford			NTS			INEL			Pantex			ORR			SRS		
				No Action (µg/m ³)	Total (µg/m ³)	Action (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	Action (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	Action (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	Action (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	Action (µg/m ³)	No Action (µg/m ³)	Total (µg/m ³)	
Carbon monoxide	Lead	8-hour	10,000	0.08	0.09	2,290	2,290.01	284	284.02	602	602.07	5	5	22	22.06						
		1-hour	40,000	0.3	0.36	2,748	2,748.04	614	614.05	2,900	2,900.36	11	11	171	171.29						
		Calendar Quarter	1.5	<0.01	<0.01	b	b	0.001	0.001	0.09	0.09	0.05	0.05	<0.01	<0.01						
		24-hour	0.5	<0.01	<0.01	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	
Nitrogen dioxide	Ozone	Annual	100	0.03	0.04	b	<0.01 ^d	4	4.02	2.15	2.23	3	3	5.7	5.7						
		1-hour	235	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	
Particulate matter less than or equal to 10 microns in diameter	Sulfur dioxide	Annual	50	<0.01	<0.01	9.4	9.4	5	5	8.73	8.73	1	1	3	3						
		24-hour	150	0.02	0.02	106	106	80	80	88.5	88.5	2	2	50.6	50.6						
Mandated by State	Hydrogen fluorides (as HF)	Annual	52	<0.01	<0.01	8.4	8.4	6	6	<0.01	0.01	2	2	14.5	14.51						
		24-hour	260	<0.01	0.03	94.6	94.6	135	135.07	<0.01	0.24	32	32	196	196.22						
		3-hour	1,300	0.01	0.2	725	725	579	579.28	<0.01	1.35	80	80.02	823	824.39						
		1-hour	1,018	0.02	0.59	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	
		1-hour	655 ^f	0.02	0.59	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	
		30-minute	1,045	c	c	c	c	c	<0.01	3.63											
Hydrogen fluorides (as HF)	Mandated by State	30-day	0.8	b	b	c	c	c	c	<0.75	<0.75	0.2	0.2	0.09	0.09						
		7-day	1.6	b	b	c	c	c	c	<0.75	<0.75	0.3	0.3	0.39	0.39						
		24-hour	2.9	b	b	c	c	c	c	0.75	0.75	0.6 ^g	0.6 ^g	1.04	1.04						
		12-hour	3.7	b	b	c	c	c	c	1.05	1.05	0.6 ^g	0.6 ^g	1.99	1.99						

Table 4.3.5.4.3-1. Estimated Operational Concentrations of Pollutants and Comparison With Most Stringent Regulations or Guidelines—Evolutionary Light Water Reactor and No Action Alternative—Continued

Pollutant	Averaging Time	Hanford			NTS			INEL			Pantex			ORR			SRS		
		Most Stringent Regulations or Guidelines ^a			Total			Total			Total			Total			Total		
		($\mu\text{g}/\text{m}^3$)	Action ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	Action ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	Action ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	Action ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	Action ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	Action ($\mu\text{g}/\text{m}^3$)	No Action ($\mu\text{g}/\text{m}^3$)
Hydrogen fluoride (as HF) (continued)	8-hour	250	b	b	c	c	c	c	c	c	c	c	c	0.6	0.6	c	c	c	c
	3-hour	4.9	b	b	c	c	c	c	c	c	4.21	4.21	c	c	c	c	c	c	c
	1-hour	112	c	c	b	b	c	c	c	c	c	c	c	c	c	c	c	c	c
Hydrogen sulfide	30-minute	111	c	c	c	c	c	c	c	c	b	b	c	c	c	c	c	c	c
	Annual	60	<0.01	<0.01	c	c	c	5	5	c	c	c	c	c	c	c	12.6	12.6	c
Total suspended particulates	24-hour	150	0.02	0.02	c	c	c	80	80	c	c	c	c	2	2	c	c	c	c
	3-hour	200	c	c	c	c	c	c	c	b	<0.01 ^d	<0.01 ^d	c	c	c	c	c	c	c
	1-hour	400	c	c	c	c	c	c	c	b	<0.01 ^d	<0.01 ^d	c	c	c	c	c	c	c
[Text deleted.]																			

^a The more stringent of the Federal and State standards is presented for the averaging time.

^b No sources of this pollutant have been identified.

^c No State standard for indicated averaging time.

^d The concentration represents the alternative contribution only.

^e Ozone, as a criteria pollutant, is not directly emitted nor monitored by the sites. See Section 4.1.3 for a discussion of ozone-related issues.

^f At Hanford, the level is not to be exceeded more than twice in any 7 consecutive days.

^g Eight-hour averaging time concentration was used.

Note: Total concentrations are based on site contribution, including concentrations from ongoing activities (No Action), and do not include the contribution from nonfacility sources. Concentration for other hazardous/toxic pollutants reported for No Action in Section 4.2 are unchanged for this alternative and are not shown here.

Source: 40 CFR 50; ID DHW 1993a; ID DHW 1995b; LLNL 1996g; NV DCNR 1995a; SC DHEC 1991a; SC DHEC 1992b; TN DEC 1994a; TN DHE 1991a; TX ACB 1987a; TX NRCC 1992a; TX NRCC 1995a; WA Ecology 1994a.

handling equipment. These noise sources would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public. Some noise sources may result in impacts such as disturbance of wildlife.

4.3.5.4.4 Water Resources

The construction and operation of an evolutionary LWR would affect water resources. Water resource requirements, and discharges provided in Tables C.1.1.3–8 and C.2.1.3–7 and Tables E.3.3.7–1 and E.3.3.7–2, were used to assess impacts to surface and groundwater. The discussion of impacts are provided for each site separately. Tables 4.3.5.4.4–1 and 4.3.5.4.4–2 present projected No Action surface and groundwater uses and discharges at each site, and the potential changes resulting from construction and operation of the proposed large or small evolutionary LWR.

Hanford Site

Surface Water. Surface water from the Columbia River would be used as the water source for construction and operation of the evolutionary LWRs. During construction, the quantity of water required for large and small LWRs would be approximately 126 million l/yr (33 million gal/yr) and 76 million l/yr (20 million gal/yr), respectively, which would represent less than 0.9- and 0.6-percent increases, respectively, over the projected No Action surface water withdrawal. These amounts would also be approximately 0.001 percent and 0.0007 percent, respectively, of the average flow of the Columbia River (3,360 m³/s [118,642 ft³/s]). These additional withdrawals would have negligible impacts on surface water availability.

During operation, annual water requirements for the large and small evolutionary LWRs would be approximately 60,560 million l/yr (15,988 million gal/yr) and 27,252 million l/yr (7,199 million gal/yr), respectively, which would represent 448- and 202-percent increases, respectively, over the projected annual No Action surface water withdrawals. The larger of these withdrawals would increase Hanford's total withdrawals to 0.05-percent of the annual average flow of the Columbia River (3,360 m³/s [118,642 ft³/s]); minimal impacts would occur to surface water availability.

[Text deleted.]

During construction of the evolutionary LWRs, sanitary wastewater from large or small reactors (104 million l/yr [27.5 million gal/yr] and 59 million l/yr [15.6 million gal/yr], respectively) would be generated and discharged to the Columbia River. The larger of these annual quantities would be 0.001 percent of the average minimum daily flow of the Columbia River. All discharges would be monitored to comply with NPDES permit limits and other discharge requirements. [Text deleted.] During operation, approximately 341 million l/yr (90 million gal/yr) and 189 million l/yr (50 million gal/yr) of sanitary and other wastewater effluent from the large or small reactor, respectively, would be recycled to the greatest extent possible and the remainder would be discharged to the Columbia River. All discharges would be monitored to comply with NPDES permit limits and other discharge requirements.

Unlike wastewater effluent from treatment facilities, which is released on a continuous basis, cooling system blowdown activities discharge greater quantities over a shorter period of time. The large or small reactor would release approximately 97.8 million l (25.8 million gal) or 44.2 million l (11.7 million gal), respectively, of treated blowdown water once a day over a 1-hour period. Without engineering measures such as those described below, these blowdown releases would increase the average flow rate of the receiving river (Columbia River) by 0.02 and 0.01 percent, respectively. Although these increases are small, the velocity of the discharges could cause erosion of the channel and increased turbidity. In addition to the impacts from the discharge velocity of the blowdown, the high temperature of the releases could also affect receiving waters. In addition, treatment of the water to be returned to the Columbia River is necessary even if the plant does not add anything. Agricultural runoff along the path of the river creates higher than "allowed" levels of nitrate and phosphate. These alone must be reduced before the water (as taken from the river) could be returned. Engineering measures incorporated in technology design adapted to site conditions could significantly reduce these impacts. Various cooling system

**Table 4.3.5.4.4-1. Potential Changes to Water Resources Resulting From the Large Evolutionary
Light Water Reactor**

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS Surface	SRS Ground
Water Source							
No Action water requirements (million l/yr)	13,511	2,400	7,570	249	14,760	127,000	13,247
No Action wastewater discharge (million l/yr)	246	82	540	141	2,277	700	0
Construction							
Water Availability and Use							
Total water requirement (million l/yr)	126	126	126	126	126	NA	126
Percent increase in projected water use ^a	0.9	5.3	1.7	50.6	0.9	NA	1.0
Water Quality							
Total wastewater discharge (million l/yr)	104	104	104	104	104	104	NA
Percent change in wastewater discharge ^b	42	127	19.4	96.7	4.5	15	NA
Percent change in streamflow	neg	NA	NA	NA	0.23 ^c	24 ^d	NA
Operation							
Water Availability and Use							
Total water requirement (million l/yr)	60,560	341	341	341	60,560	60,219	341
Percent increase in projected water use ^e	448	14.2	4.5	137	410	47.4	2.6
Water Quality							
Total sanitary wastewater discharge (million l/yr)	341 ^f	341	341	341	341 ^f	341 ^f	NA
Percent change in wastewater discharge ^g	138.6	415.9	63.1	241.8	15.0	48.7	NA
Percent change in streamflow from wastewater discharge	NA	NA	NA	NA	0.7 ^c	6.8 ^d	NA
Blowdown discharge to surface waters (million l/yr) ^h	23,470	NA	NA	NA	23,470	23,470	NA
Percent change in annual streamflow from blowdown water discharge	0.02 ⁱ	NA	NA	NA	49.6 ^c	465 ^d	NA

Table 4.3.5.4-1. Potential Changes to Water Resources Resulting From the Large Evolutionary Light Water Reactor—Continued

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS	SRS
Floodplain							
Is action in 100-year floodplain?	No	No	No	No	No	NA	No
Is critical action in 500-year floodplain?	No	Uncertain	No	No	Uncertain	Uncertain	Uncertain

^a Percent increases in water requirements during construction of an evolutionary LWR are calculated by dividing water requirements for the facility (126 million l/yr) with that for each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

^b Percent changes in wastewater discharged during construction of an evolutionary LWR are calculated by dividing wastewater discharge of the facility (104 million l/yr) with that for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

^c Percent changes in stream flow from wastewater/blowdown discharges are calculated from the average flow of Clinch River (132 m³/s) and East Fork Poplar Creek (1.5 m³/s). The comparison for East Fork Poplar Creek is shown in the table.

^d Percent changes in stream flow from wastewater/blowdown discharges are calculated from the minimum flow of the Fourmile Branch (0.16 m³/s).

^e Percent increases in water requirements during operation of an evolutionary LWR are calculated by dividing water requirements (341 million l/yr) for a dry site; and (60,560 million l/yr) for a wet site with that for each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr) of groundwater and 127,000 million l/yr of surface water. At SRS, only cooling water make-up will be supplied from surface water.

^f Does not include cooling tower blowdown that would be treated and discharged to the river.

^g Percent changes in wastewater discharged during operation of an evolutionary LWR are calculated by dividing wastewater discharge rate for the new facility (341 million l/yr) with that for each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

^h Blowdown is expected to occur once a day over a 1-hour period, rather than continuously over the course of the day. As such, the discharge rate would be much greater for a shorter period of time.

ⁱ Percentage change from blowdown is calculated from the annual average flow of the Columbia River (3,360 m³/s).

Note: NA=not applicable; neg=negligible. Construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1995a.1; INEL 1995a.1; LLNL 1996g; NTS 1993a.4; ORLMES 1995e; PX 1995a.1; SRS 1995a.2.

Table 4.3.5.4.4-2. Potential Changes to Water Resources Resulting From the Small
Evolutionary Light Water Reactor

Affected Resource Indicator	Hanford		NTS		INEL		Pantex		ORR		SRS	
Water Source	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground
No Action water requirements (million l/yr)	13,511	2,400			7,570	249			14,760	127,000		
No Action wastewater discharges (million l/yr)	246	82			540	141			2,277	700		
Construction												
Water Availability and Use												
Total water requirement (million l/yr)	76	76			76	76			76	NA		76
Percent increase in projected water use ^a	0.6	3.2			1.0	30.5			0.5	NA		0.6
Water Quality												
Total wastewater discharge (million l/yr)	59	59			59	59			59	59		NA
Percent change in wastewater discharge ^b	24	72			10.9	41.8			2.6	8.4		NA
Percent change in streamflow	neg	NA			NA	NA			0.1 ^c	1.2 ^d		NA
Operation												
Water Availability and Use												
Total water requirement (million l/yr)	27,252	189.3			189.3	189.3			27,252	27,063		189.3
Percent increase in projected water use ^c	202	7.9			2.5	75.9			185	21.3		1.4
Water Quality												
Total sanitary wastewater discharge (million l/yr)	189 ^f	189			189	189			189 ^f	189 ^f		NA
Percent change in wastewater discharge ^g	77	230			35	134			8.3	27		NA
Percent change in streamflow	NA	NA			NA	NA			0.4 ^c	3.7 ^d		NA
Blowdown discharge to surface waters (million l/yr) ^h	10,598	NA			NA	NA			10,598	10,598		NA
Percent change in annual streamflow from blowdown water discharge	0.01 ⁱ	NA			NA	NA			22.4 ^c	210 ^d		NA

Table 4.3.5.4.4-2. Potential Changes to Water Resources Resulting From the Small Evolutionary Light Water Reactor—Continued

Affected Resource Indicator	Hanford	NTS	INEL	Pantex	ORR	SRS	SRS
Floodplain							
Is action in 100-year floodplain?	No	No	No	No	No	No	NA
Is critical action in 500-year floodplain?	No	Uncertain	No	No	Uncertain	Uncertain	Uncertain

^a Percent increases in water requirements during construction of an evolutionary LWR are calculated by dividing water requirements (76 million l/yr) with that for No Action water requirements at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL, (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr).

^b Percent changes in wastewater discharged during construction of an evolutionary LWR are calculated by dividing water discharges (59 million l/yr) with that for No Action water requirements at each site: Hanford (246 million l/yr), NTS (recycled 82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (1,657 million l/yr), and SRS (700 million l/yr).

^c Percent changes in stream flow from wastewater/blowdown discharges are calculated from the average flow of Clinch River (132 m³/s) and East Fork Poplar Creek (1.5 m³/s). The comparison for the East Fork Poplar Creek is shown in the table.

^d Percent changes in stream flow from wastewater/blowdown discharges are calculated from the minimum flow of Fourmile Branch (0.16 m³/s).

^e Percent increases in water requirements during operation of an evolutionary LWR are calculated by dividing water requirements (189.3 million l/yr for a dry site; 27,252 million l/yr for a wet site) with that for each No Action water requirements at each site: Hanford (13,511 million l/yr), NTS (2,400 million l/yr), INEL (7,570 million l/yr), Pantex (249 million l/yr), ORR (14,760 million l/yr), and SRS (13,247 million l/yr of groundwater and 127,000 million l/yr of surface water). At SRS, only cooling water make-up will be supplied from surface water.

^f Does not include cooling tower blowdown that would be treated and discharged to the river.

^g Percent changes in wastewater discharged during operation of an evolutionary LWR are calculated by dividing water discharges (189 million l/yr) with that for No Action discharge at each site: Hanford (246 million l/yr), NTS (82 million l/yr), INEL (540 million l/yr), Pantex (141 million l/yr), ORR (2,277 million l/yr), and SRS (700 million l/yr).

^h Blowdown is expected to occur once a day over a 1-hour period, rather than continuously over the course of the day. As such, the discharge rate would be much greater for a shorter period of time.

ⁱ Percent change from blowdown is calculated from the annual average flow of the Columbia River (3,360 m³/s).

Note: NA=not applicable; neg=negligible; construction impacts are considered to be temporary, lasting only throughout the construction period. Impacts from operations would occur continuously.

Source: HF 1995a:1; INEL 1995a:1; LLNL 1996g; NTS 1993a:4; OR LMES 1995e; PX 1995a:1; SRS 1995a:2.

blowdown disposal options would be evaluated in detail in the future site-specific documents. All discharges to surface waters would be monitored to comply with discharge requirements.

The evolutionary LWRs would be located near the WNP-1, an area which is above the 100-year, 500-year, and probable maximum flood boundaries; flooding from dam failures; and flooding from a landslide resulting in river blockage.

Groundwater. No groundwater would be used for construction or operation of the evolutionary LWRs; therefore there would be no impact to groundwater availability.

Construction and operation of the evolutionary LWRs would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds which does not evaporate, however, could percolate downward into the near surface aquifer groundwater. This water would be monitored and would not be discharged until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors limiting potential impacts to groundwater quality are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

[Text deleted.] Although the Columbia River is composed of fresh water, it does contain very small quantities of naturally occurring salts. These salts would be concentrated in a wet cooling tower and released with stream emissions from the tower. This is known as salt drift and may damage vegetation in a small area near the facility. Because rainfall at Hanford is minimal, these salts may not be adequately flushed from the soil column. Impacts would be analyzed in future tiered, site-specific NEPA documents, as appropriate.

Nevada Test Site

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the evolutionary LWRs. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the large and small evolutionary LWRs, sanitary wastewater (104 million l/yr [27.5 million gal/yr] and 59 million l/yr [15.6 million gal/yr], respectively) would be generated. During operation, approximately 341 million l/yr (90 million gal/yr) and 189 million l/yr (50 million gal/yr) of sanitary and other wastewater from the large or small reactors, respectively, would be discharged to a new wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycle as makeup to the cooling tower or boiler.

There have been no studies conducted to assess the 500-year floodplain boundaries at NTS. Studies of the 100-year floodplain showed it to be confined to the Jackass Flats and Frenchman Lake areas. The proposed site for the evolutionary LWRs is not located in either of these areas. However, since the NTS is in a region where most flooding occurs by locally intense thunderstorms which can create brief (less than 6 hours) flash floods, the facilities would be designed to withstand such flooding. An assessment of the 500-year floodplain at NTS could be accomplished in future environmental studies.

Groundwater. All water required for construction and operation would be supplied from groundwater. Construction water requirements for the large and small reactors (126 million l/yr [33 million gal/yr] and 76 million l/yr [20 million gal/yr], respectively) would represent 5.3- and 3.2-percent increases over the projected annual groundwater usage. Annual operation water requirements for the large and small reactors (341 million l/yr [90 million gal/yr] and 189.3 million l/yr [50 million gal/yr], respectively) would represent approximately 14.2- and 7.9-percent increases over the projected groundwater usage, respectively.

Based on the minimum estimated recharge (38 billion l/yr [10 billion gal/yr]), the increases in groundwater withdrawal attributed to operation of the large and small reactors would be 0.9- and 0.5-percent of the estimated annual recharge, respectively. Either of these additional withdrawals would not have any impact on groundwater availability.

Construction and operation of the evolutionary LWRs would not result in direct discharges to groundwater. Treated wastewater discharged to disposal ponds, however, could percolate downward toward the groundwater of the Valley-Fill Aquifer. This water would be monitored and would not be discharged to the ponds until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Because dry cooling towers would be used, salt would not be released from the cooling tower. Blowdown recycle would couple reverse osmosis with an evaporator and crystallizer system that would remove the dissolved solids from blowdown so the water could be recycled to the cooling tower. This system would reduce requirements for makeup water, and discharge would not require disposal. The solids from the crystallization processes would be disposed of as solid waste. This system would reduce the salt from blowdown.

Idaho National Engineering Laboratory

Surface Water. No surface water would be withdrawn for any construction or operation activities associated with the facility; groundwater would be used as the water source for the evolutionary LWRs. Therefore, there would be no impacts to surface water availability.

[Text deleted.]

During construction of the large and small evolutionary LWRs, sanitary wastewater (104 million l/yr [27.5 million gal/yr] and 59 million l/yr [15.6 million gal/yr]), respectively, would be generated, treated, and discharged to evaporation/percolation ponds, or be available for recycle. During operation, approximately 341 million l/yr (90 million gal/yr) and 189 million l/yr (50 million gal/yr) of sanitary and other wastewater from the large or small reactors, respectively, would be discharged to this wastewater treatment system. After treatment, all wastewater generated during construction and operation would be available for recycle as makeup to the cooling tower or boiler. If not recycled, all discharges would be monitored to comply with discharge limits.

The potential site for the evolutionary LWRs is not located in an area historically prone to flooding or within the flood zone which could occur as a result of the failure of the MacKay Dam during a maximum probable flood which would be more critical than either the 100- or 500-year flood. However, because INEL is in a region where flash floods could occur, the facilities would be designed to withstand such flooding.

Groundwater. All water required for construction and operation would be supplied from groundwater from the Snake River Plain Aquifer. As shown in Tables 4.3.5.4.4-1 and 4.3.5.4.4-2, construction water requirements for the large and small reactors (126 million l/yr [33 million gal/yr] and 76 million l/yr [20 million gal/yr], respectively) would represent 1.7- and 1.0-percent increases over the projected annual No Action groundwater usage and are within INEL's permitted allotment. Operation water requirements for the large and small reactors (341 million l/yr [90 million gal/yr] and 189.3 million l/yr [50 million gal/yr], respectively) would represent 4.5- and 2.5-percent increases over the projected annual No Action groundwater usage, respectively. The larger of these withdrawals would increase the total projected amount to be pumped at INEL to 18.4-percent of the allotment during operation; INEL would still be well within the total groundwater allotment. As discussed in Section 3.4.4, a groundwater allotment not to exceed 43,000 million l/yr (11,360 million gal/yr), has been negotiated by DOE with the Idaho Department of Water Resources (DOE 1991c:4-73).

Construction and operation of the evolutionary LWRs would not result in direct discharges to groundwater and would not be expected to contribute to existing near surface contamination. Treated wastewater discharged to disposal ponds, however, would percolate downward toward the groundwater of the Snake River Plain Aquifer. This water would be monitored and would not be discharged until contaminant levels are within the limits specified. Impacts to groundwater quality are therefore not expected. In addition, other factors limiting potential impacts to groundwater are the combined effects of a deep water table, low discharge volumes, and high evaporation rates.

Because dry cooling towers would be used, salt would not be released from the cooling tower. Blowdown recycle would couple reverse osmosis with an evaporator and crystallizer system that would remove the dissolved solids from blowdown so the water could be recycled to the cooling tower. This system would reduce requirements for makeup water, and discharge would not require disposal. The solids from the crystallization processes would be disposed of as solid waste. This system would reduce the salt from blowdown.

Pantex Plant

Surface Water. All water required for construction or operation of a large or small evolutionary LWR would be supplied from either groundwater or possibly reclaimed wastewater. If reclaimed wastewater from the city of Amarillo Hollywood Road Wastewater Treatment Plant is used to accommodate water requirements at Pantex, the available reclaimed wastewater is anticipated to increase from 9,671 million l/yr (2,555 million gal/yr) to 16,580 million l/yr (4,380 million gal/yr) by the year 2010.

All wastewater would be treated and either recycled for cooling system make-up or released to playa lakes. No wastewater would be discharged to surface water during operation of the facilities. During construction, treated sanitary wastewater would be discharged to playa lakes. [Text deleted.] Nonhazardous wastewater discharges would range from 104 million l/yr (27.5 million gal/yr) for the large and 59 million l/yr (15.6 million gal/yr) for the small evolutionary LWR. Discharge of wastewater generated during construction of these facilities to playas would not result in an exceedance of the monthly average limit of 2.46 million l/day (0.65 million gal/day).

During operation, utility, process and sanitary wastewater for the small and large evolutionary LWR not recycled would be treated prior to discharge into the playas. Treated effluent would be monitored to comply with discharge requirements. The extent to which treated effluent or stormwater would be recycled for reuse within the plant would be determined during site-specific studies.

The proposed location for the evolutionary LWR is in the northwest corner of the Pantex facility, west of the burning grounds. Since no 100-year, 500-year, or standard project flood boundaries have been delineated in this area, there would be no impacts to floodplains. However, flooding in other areas of Pantex could occur due to the runoff associated with precipitation and ponding in local playas (LLNL 1988a:XVI).

Groundwater. Either groundwater or reclaimed wastewater would be used for construction and operation of the facility. The city of Amarillo is currently considering supplying Pantex with tertiary treated sanitary wastewater from the city of Amarillo Hollywood Road Wastewater Treatment Plant. Although not strictly groundwater or surface water, the reclaimed wastewater is discussed in this section because Pantex would still be withdrawing approximately 249 million l/yr (65.8 million gal/yr) from the aquifer in 2005.

As shown in Tables 4.3.5.4.4-1 and 4.3.5.4.4-2, construction of either a large LWR or a small LWR would represent a 50.6 and 30.5 percent increase in the projected water use, which would be 6.6 and 4.0 percent of the capacity of the groundwater system (1,900 million l/yr [502 million gal/yr]) or less than 0.76 and 0.46 percent of the projected available reclaimed wastewater (16,580 million l/yr [4,380 million gal/yr]). Operation of either a large or small evolutionary LWR would increase groundwater withdrawals by 137 and 75.9 percent, respectively, which would represent 17.9 and 9.9 percent, respectively, of the capacity of the groundwater system, or approximately 2.0 and 1.3 percent, respectively, if reclaimed wastewater were used as the water

source. Previous studies have shown that when the Amarillo City Well Field pumped 18.5 billion l/yr (4.9 billion gal/yr) from the Ogallala aquifer, an average of 1.8 m/yr (5.9 ft/yr) decline in the water table occurred over a 10-year period. Operating the large or small evolutionary LWR at Pantex would result in minor drawdowns. Either of these additional groundwater withdrawals would add to the existing decline in water levels of the Ogallala Aquifer. However, there should be no regional impacts to groundwater levels from either of these additional water withdrawals. The total groundwater withdrawal including this facility at Pantex would be 590 million l/yr (156 million gal/yr) for a large evolutionary LWR and 438 million l/yr (116 million gal/yr) for a small evolutionary LWR. Because of expected cutbacks in other programs, the amounts for either a large or small evolutionary LWR would be 29.5 and 47.6 percent, respectively, less than what is currently being withdrawn (836 million l/yr [221 million gal/yr]) from wells at Pantex.

Construction and operation of the evolutionary LWRs would not result in direct discharges to groundwater. As discussed previously, treated wastewater discharged to playas could, however, percolate downward toward the groundwater of the near surface aquifer. All contaminants that have entered the near surface aquifer are expected to move downgradient to the north, away from existing facilities. Because no groundwater would be withdrawn for the project from the perched aquifer, no effect on plume migration would occur. Pantex will continue to evaluate groundwater contamination in both the perched and Ogallala Aquifers.

Although the expected drawdowns caused by withdrawing the water required for this alternative are small, the overall decline in groundwater levels in the Amarillo area is of concern. Possible groundwater conservation measures at Pantex that could be considered, including decreasing research farm irrigation demands through dry farming, installing dripless faucets, and process water reuse. In addition, to alleviate some of the effects from pumping groundwater from the Ogallala Aquifer, the city of Amarillo is considering supplying treated wastewater to Pantex from the Hollywood Road Wastewater Treatment Plant for industrial use. However, details of this measure have not been determined.

Because dry cooling towers would be used, salt would not be released from the cooling tower. Blowdown recycle would couple reverse osmosis with an evaporator and crystallizer system that would remove the dissolved solids from blowdown so the water could be recycled to the cooling tower. This system would reduce requirements for makeup water, and discharge would not require disposal. The solids from the crystallization processes would be disposed of as solid waste. This system would reduce the salt from blowdown.

Oak Ridge Reservation

Surface Water. Water required for construction and operation of the evolutionary LWRs would be obtained from the Clinch River and its tributaries. [Text deleted.]

During construction of the large and small evolutionary LWRs, the quantity of water required would be approximately 126 million l/yr (33 million gal/yr) and 76 million l/yr (20 million gal/yr), respectively. These quantities would represent 0.9- and 0.5-percent increases over the projected No Action surface water withdrawal. The largest increase would cause the total ORR withdrawals to increase to 0.4-percent of the average flow of the Clinch River. Minimal impacts to surface water availability would occur. During operation of the large and small reactors, water requirements would be approximately 60,560 million l/yr (16,000 million gal/yr) and 27,252 million l/yr (7,200 million gal/yr), respectively. These quantities would represent 410- and 185-percent increases over the projected annual No Action water withdrawal. The largest increase would cause the total ORR withdrawals to increase to 1.8-percent of the average flow of the Clinch River (132 m³/s [4,647 ft³/s]). Minimal impacts to surface water availability would occur.

During construction of the large and small evolutionary LWRs, sanitary wastewater (approximately 104 million l/yr [27.5 million gal/yr] and 59 million l/yr [15.6 million gal/yr], respectively) would be generated. During operation, 341 million l/yr (90 million gal/yr) and 189 million l/yr (50 million gal/yr), respectively, of

wastewater effluent would be generated by the facility. The total quantity of wastewater discharged to the Clinch River from ORR would increase to a maximum of 0.008 percent of the Clinch River's average flow and 0.7 percent of the East Fork Poplar Creek flow. No impacts are expected. All discharges would be monitored to comply with discharge requirements.

Unlike wastewater effluent from treatment facilities, which is released on a continuous basis, cooling system blowdown activities discharge greater quantities over a shorter period of time. The large and small reactors would release approximately 97.8 million l/day (25.8 million gal/day) and 44.2 million l/day (11.7 million gal/day), respectively, of blowdown water once a day over a 1-hour period or 23,470 million l/yr (6,200 million gal/yr) and 10,598 million l/yr (2,800 million gal/yr). Without engineering measures such as those described below, the blowdown releases from the large reactor would temporarily increase the average flow rate of the receiving streams by approximately 20 percent (Clinch River) and 1,880 percent (East Fork Poplar Creek). Increases from the small reactor blowdown would be approximately 9.3 percent (Clinch River) and 820 percent (East Fork Poplar Creek). These discharges would cause scouring of the streambeds, erosion of stream channels, increased turbidity, and potential flooding of areas. In addition to impacts from the discharge velocity of the blowdown, the high temperature of the releases could also affect receiving waters. As discussed in Section 3.6.4, DOE is currently involved with remediation of East Fork Poplar Creek under CERCLA. Any discharges including cooling tower blowdown, that may potentially impact East Fork Poplar Creek would require engineering design mitigation measures to avoid interference with the goals of the remediation effort. Engineering measures incorporated in technology design adapted to site conditions could significantly reduce these impacts. Various cooling system blowdown disposal options would be evaluated in detail in future site-specific documents. All discharges to surface waters would be monitored to comply with discharge requirements.

The evolutionary LWRs would be located outside the 100-year floodplain; there would be no impact to the floodplain. The 500-year floodplain has not been determined in this area but could developed in future studies.

Groundwater. All water for construction and operation would be taken from the Clinch River; groundwater availability would not be affected. All process, utility and sanitary wastewater would be treated prior to discharge into East Fork Poplar Creek. Minimal impact to groundwater quality is expected.

Any salt coming from the cooling towers would have originated from the Clinch River. Because the salt is concentrated in a wet cooling tower, it can potentially damage vegetation in a small area near the facility. At ORR, there is adequate rainwater and groundwater flow such that the salt generated from the cooling tower would be flushed into the groundwater and diluted. The groundwater and surface water systems are connected such that the salt originating from the Clinch River and reaching the groundwater will eventually return to the river, with no net change in the total amount of salt in the ecological system.

Savannah River Site

Surface Water. Groundwater would be used for construction and operation of the evolutionary LWRs and surface water from the Savannah River would be used for cooling water makeup. Operation of a large and small evolutionary LWR would require approximately 60,219 million l/yr (15,908 million gal/yr) and 27,063 million l/yr (7,150 million gal/yr) of cooling water. These amounts would represent a 47.4- and a 21.3-percent increase, respectively, over the projected no action surface water use at SRS. These amounts are also approximately 1.2- and 0.6-percent, respectively, of the Savannah River's minimum flow, and would not be expected to affect downstream users. [Text deleted.]

During construction of the large and small evolutionary LWRs, sanitary wastewater (approximately 104 million l/yr [27.5 million gal/yr] and 59 million l/yr [15.6 million gal/yr], respectively) would be generated and discharged to the sitewide wastewater treatment system. During operation, a total of 341 million l/yr (90 million gal/yr) and 189 million l/yr (50 million gal/yr) of wastewater would be generated by the new large

and small facilities, respectively, causing increases of up to 48.7 and 27 percent in the discharge from the site-wide wastewater treatment system. The possibility of these increases causing exceedance of the NPDES-permitted maximum discharge would be addressed in site-specific NEPA documents, as appropriate.

Unlike wastewater effluent from treatment facilities, which is released on a continuous basis, cooling system blowdown activities discharge greater quantities over a shorter period of time. The large or small reactor would release approximately 97.8 million l (25.8 million gal) or 44.2 million l (11.7 million gal), respectively, of blowdown water once a day over a 1-hour period. Without engineering measures such as those described below, these blowdown releases would increase the average flow rate of the receiving stream (Fourmile Branch) by over 17,000 and 7,600 percent, respectively. These discharges would cause scouring of the streambeds, erosion of stream channels, increased turbidity, and potential flooding of areas. In addition to impacts from the discharge velocity of the blowdown, the high temperature of the releases could also affect receiving waters. Engineering measures incorporated in technology design adapted to site conditions could significantly reduce these impacts. Various cooling system blowdown disposal options would be evaluated in detail in future site-specific documents. All discharges to surface waters would be monitored to comply with discharge requirements.

As an alternative to discharging blowdown water to Fourmile Branch, water from cooling tower blowdown could be discharged to Par Pond via pre-cooling ponds (that is, Pond 2, Pond 5, and Pond C). Makeup water currently is pumped into Par Pond from the Savannah River to maintain its level and the proper rate of flow in Lower Three Runs Creek (DOE 1992e:5-216). If blowdown water from the reactor were sent to Par Pond, no impacts to wetlands would be anticipated since there would be no change in the level of Par Pond or the flow rate of Lower Three Runs Creek.

Fire sprinkler water and truck hose-down water would be collected in tanks, monitored for radioactivity, and then transferred by pipeline or tanker to treatment facilities as required. Uncontaminated water would be pumped to storm drains.

The evolutionary LWRs would not be located in the 100-year floodplain. Information on the location of the 500-year floodplain at SRS is currently available only for a limited number of specific project areas. Information on the 500-year floodplain could be developed in future environmental studies.

Groundwater. Groundwater from the Cretaceous aquifer would be used as the water source for construction and operation of the new evolutionary LWRs. During construction, the quantity of water required for the large and small reactors would be approximately 126 million l/yr (33 million gal/yr) and 76 million l/yr (20 million gal/yr), respectively, which would represent 1.0- and 0.6-percent increases over the projected No Action groundwater withdrawal. Neither of these additional withdrawals would impact groundwater availability.

Water requirements during operation for the large and small reactors would be approximately 341 million l/yr (90.0 million gal/yr) and 189.3 million l/yr (50 million gal/yr), respectively. These increases would represent 2.6- and 1.4-percent increases in the projected groundwater usage at SRS. The water withdrawals from groundwater would not impact regional groundwater levels. Previous studies using numerical simulations of groundwater withdrawals from the Cretaceous aquifer up to 6 times greater than that required for the large reactor indicate drawdown of almost 2.1 m (6.9 ft) at the well head, but smaller in overlying aquifers and not extending beyond SRS boundaries in any aquifer (DOE 1991c:5-196). Therefore, it is expected that the withdrawals attributed to the large reactor would cause a small drawdown at the well head and would not impact any aquifers in the area. Withdrawals attributed to the small reactor would cause slightly less drawdown at the well head. No wastewater would be discharged directly to groundwater; therefore, groundwater quality would not be affected.

Any potential salt coming from the cooling tower would have originated from the Savannah River. Because the salt is concentrated in a wet cooling tower, it may damage vegetation in a small area near the facility. At SRS,

there is adequate rainwater and groundwater flow such that any salt concentrations from the cooling tower would be flushed into the groundwater and diluted. The groundwater and surface water systems are connected such that the salt originating from the Savannah River and reaching the groundwater would eventually return to the river, with no net change in the total amount of salt in the ecological system.

| [Text deleted.]

4.3.5.4.5 *Geology and Soils*

This section discusses the environmental impacts to the geologic and soil resource as related to the construction and operation of an evolutionary LWR. An evolutionary LWR, at any of the sites analyzed, would involve some ground-disturbing construction activities (284 ha [700 acres]) for two unit large or small, and 142 ha [350 acres] for one unit large or small) that would affect the soil erosion potential. The key factors affecting soil erosion potential are the amount of land disturbed and climate. Specifically, the relative annual amount of precipitation (rain) is greater at ORR and SRS than at Pantex, Hanford, INEL, and NTS. Combining these key factors together, the relative soil erosion potential for a site can be categorized as slight, moderate, or severe. Implementation of this alternative requires that a greater amount of land be disturbed relative to the other reactor alternatives. Therefore, this alternative has the greater relative impact to the soil erosion potential.

No apparent direct or indirect effects on the geologic resource are anticipated. Neither facility construction and operational activities nor site infrastructure improvements would restrict access to potential geologic resources.

The soil erosion potential from direct (facility construction) and indirect (site infrastructure improvements) impacts associated with construction and operational activities is low for Pantex, Hanford, INEL, and NTS. The soil erosion potential for ORR and SRS during construction and operational activities is moderate due primarily to greater relative annual precipitation. Soil disturbance would occur primarily from ground-disturbing construction activities (foundation preparation) and associated building construction laydown areas that can expose the soil profile and lead to a possible increase in soil erosion as a result of wind and water action. Soil loss would depend on wind velocities (increased wind velocities and durations increase potential soil erosion), the frequency and severity of rain, and the size and location of ground-breaking activities with respect to local drainage and wind patterns.

Operational effects to the soil resource would be minimal, assuming typical landscaping and ground cover improvements were employed. Net soil disturbance during operation would be considerably less than that during construction, because areas previously without ground cover would have some type of improvement (buildings, roads and landscaping). Although erosion from stormwater runoff and wind action could occasionally occur during operation, it is anticipated to be minimal.

[Text deleted.]

4.3.5.4.6 Biological Resources

Construction of the evolutionary LWR would require 284 ha (700 acres) of land for two units large or small, and 142 ha (350 acres) for one unit large or small at each of the DOE sites analyzed. This includes areas on which plant facilities would be constructed, as well as areas used for construction laydown. Consultation with USFWS and State agencies would be conducted at the site-specific level, as appropriate to avoid potential impacts to threatened and endangered species, and other protected species and habitat.

Hanford Site

It is assumed that either the large or small evolutionary LWR would be located near the WNP-1 and WNP-2 sites. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Use of the existing WNP-1 site for either the large or small evolutionary LWR would result in some impact to terrestrial resources at Hanford. Less mobile animals, such as reptiles and small mammals, would not be expected to survive while more mobile animals, such as larger mammals and birds, could move from the area. The survival of the latter group of animals would depend on the carrying capacity of surrounding areas. Nests and young animals living within disturbed areas may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction.

The operation of cooling towers associated with either the large or small evolutionary LWR would create salt drifts that could, if deposited at a high enough rate, affect plants growing in the vicinity of the towers. Previous studies of a tritium production LWR at the WNP-1 site predicted that up to about 13 ha (32 acres) could be affected by deposition rates of 17.1 kg/ha (15.2 lb/acre) per month (DOE 1992e:5-55). This is the rate at which salt stress symptoms can become visible in sensitive plant species. Salt drift impacts which may be associated with either evolutionary LWR option will be evaluated in site-specific NEPA documentation.

Wetlands. Impacts to wetlands from either the large or small evolutionary LWR would not be expected since the WNP-1 site is not located near wetlands and the intake and discharge lines for this facility are already built.

Aquatic Resources. Although no aquatic habitat occurs on the WNP-1 site, past studies of a tritium production LWR at the site suggest the operation of the water intake and discharge structures could impact aquatic organisms and habitats associated with the Columbia River (DOE 1992e:5-58). Impacts from the small evolutionary LWR would be less than for the large reactor since water requirements are lower. Removal of cooling water from the river would cause the entrainment and subsequent mortality of planktonic organisms, including the eggs and larvae of certain fish species. Fish species in the Hanford Reach of the Columbia River that have planktonic egg and larval stages, and thus would be most affected by entrainment, include minnows, suckers, and mountain white fish. Eggs and fry of salmonid species are less likely to be entrained because they are not planktonic. It is not expected that free swimming salmon fry would be entrained because they typically occupy shallow, gravel areas near the stream bank away from the intake structure, which would be located away from the shore. Because a relatively small percentage of the total water volume passing the site would enter the intake, entrainment losses would not be expected to affect the viability of any populations of aquatic organisms in the Hanford Reach.

Larger fish in the immediate vicinity of the intake structure could be impinged and killed on the water intake screens. Past experience indicates that operation of the WNP-2 reactor at Hanford has resulted in only minimal loss of fish from impingement (DOE 1992e:5-58).

An additional potential source of impact to aquatic resources is the discharge of cooling tower blowdown to the Columbia River. Impacts to aquatic organisms from this source would likely be limited since thermal limits would be established as part of the NPDES permit and because heat (and chemicals) would be readily dissipated

as the discharge plume mixed with river water. Past studies associated with the WNP-2 Plant have indicated that temperatures were within 0.7 °C (1.9 °F) of the ambient river temperature at all monitoring stations downstream of the outfall. It would be expected that relatively immobile organisms, such as benthic macroinvertebrates, would be most affected. Studies of Chinook salmon and steelhead trout migrating past Hanford reactor discharge outfalls suggest that thermal discharges to the Columbia River would not affect fish. These studies have demonstrated that (1) the spawning run was unaffected by either on-shore or mid-river thermal discharges, (2) migration was unaffected when fish encountered warmer waters, and (3) salmonids were able to avoid areas with adverse temperatures and continue their migratory runs (DOE 1992e:5-58,5-59). Potential impingement, entrainment, and thermal impacts will be analyzed in detail in site-specific NEPA documentation if the Hanford site is chosen for the evolutionary LWR.

Threatened and Endangered Species. It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of either the large or small evolutionary LWR near the existing WNP-1 site. Most new construction would take place in previously disturbed areas for the WNP-1 site. However, if sagebrush habitat is disturbed, several State-listed and candidate species could lose breeding and foraging habitat, including the ferruginous hawk, loggerhead shrike, pygmy rabbit, sage sparrow, sage thrasher, western burrowing owl, and western sage grouse. Preactivity surveys would be completed as appropriate prior to construction to determine the existence of special status plant or animal species in the area to be disturbed. Since existing intake and discharge facilities would be used, special status species found on or near the Columbia River would not be impacted by construction activities.

During operation, water withdrawals and discharge may cause impacts to several special status species. Water withdrawal from existing intake structures could cause entrainment and impingement impacts to several State-monitored fish species. The discharge of heated effluent could cause the great Columbia River spire snail and giant Columbia River limpet to avoid the immediate area of the discharge. The potential for these impacts would be less for the small evolutionary LWR since its water requirements would be less.

Nevada Test Site

It is assumed that either the large or small evolutionary LWR would be located in the Frenchmen Flat area of NTS. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed. Impacts described below would be similar for either reactor alternative since the land area disturbed would be the same for both and each would use a dry cooling system.

Terrestrial Resources. Construction and operation of the evolutionary LWR at NTS would result in the disturbance of terrestrial habitat equaling about 0.08 percent of NTS. This includes areas on which plant facilities would be constructed as well as areas revegetated following construction. Vegetative cover within the assumed facility location, which is primarily creosote bush (Figure 3.3.6-1), would be destroyed during land clearing operations. Creosote bush communities are well represented on NTS.

Construction of the evolutionary LWR would affect animal populations. Less mobile animals, such as reptiles and small mammals, within the project area would not be expected to survive. Construction activities and noise could cause larger mammals and birds in construction and adjacent areas and would move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction but not occupied by facility structures would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas. Impacts to vegetation from salt drift would not occur since a closed cycle cooling system would be used.

Wetlands. Construction and operation of the evolutionary LWR would not affect wetlands because there are no wetlands near the assumed facility location.

Aquatic Resources. Construction and operation of the evolutionary LWR would not affect aquatic resources because there are no permanent surface water bodies near the assumed facility location. Temporary aquatic habitat may develop in evaporation and retention ponds, as well as in natural channels in the immediate vicinity of NPDES-permitted outfalls.

Threatened and Endangered Species. The threatened desert tortoise is a federally listed species that could be affected by construction of the evolutionary LWR at NTS. Construction activities such as land clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicle traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by the USFWS (NT DOI 1992b:8-15). Recommended mitigation measures included providing worker training; putting restrictions on vehicle speeds and off-road movement; conducting clearance surveys prior to surface disturbance; approving stop work authority if tortoises are found within work areas; removing tortoises from roadways and work area; placing permanent and temporary tortoise-proof fencing around trenches, landfills, and treatment ponds; inspecting trenches; and having biologists survey when heavy equipment is in use. The USFWS would be consulted, and USFWS recommendations would be implemented if NTS were selected as the location for the evolutionary LWR.

[Text deleted.] Any listed plant species (Table 3.3.6–1) located within the construction area would be lost during land-clearing activities. Preactivity surveys would be completed as appropriate prior to construction to determine the existence of these species in the area to be disturbed.

During facility operation, vehicle traffic would pose a hazard to the desert tortoise similar to the hazard caused by current traffic. Extensive measures, including personnel training, are presently being taken to ensure that drivers on NTS avoid the tortoise. [Text deleted.] Groundwater levels in Devils Hole cavern are not expected to change due to operation of the evolutionary LWR (Section 4.3.5.4.4); therefore, impacts to the Devils Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Idaho National Engineering Laboratory

It is assumed that either the large or small evolutionary LWR would be located in the south central part of INEL, 3.2 km (2 mi) northeast of the ICPP. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed. Impacts described below would be similar for either reactor alternative since the land would be the same for both and each would use a dry cooling system.

Terrestrial Resources. Construction and operation of the evolutionary LWR would result in the disturbance of terrestrial habitat equaling about 0.1 percent of INEL. Vegetation within the assumed site would be destroyed during land clearing operations. Big sagebrush is the dominant plant within the proposed site. Plant communities in which big sagebrush is the dominant overstory species are well represented on INEL, but are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture.

Construction of the evolutionary LWR would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise

would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Because pronghorn use of the assumed site is relatively low, the facility should not have a lasting impact on these species. Nests and young animals living within the project area may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas disturbed by construction but not occupied by facility structures would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the evolutionary LWR. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering disturbed areas. Impacts to vegetation from salt drift would not occur since dry cooling towers would be used.

Wetlands. Construction and operation of the evolutionary LWR would not affect wetlands since there are no wetlands near the assumed facility location. Wetlands associated with the Big Lost River are located 2.4 km (1.5 mi) from the site; therefore, impacts to these wetlands are not expected.

Aquatic Resources. Construction and operation of the evolutionary LWR would not impact aquatic resources since there are no surface water bodies near the assumed facility location. The nearest surface water body is in the Big Lost River which is located 2.4 km (1.5 mi) from the facility location. Temporary aquatic habitat may develop in evaporation and retention ponds, as well as in natural channels in the immediate vicinity of NPDES permitted outfalls.

Threatened and Endangered Species. It is unlikely that federally listed threatened or endangered species would be affected by construction of the evolutionary LWR, but several State-status species may be affected. [Text deleted.] Burrows and foraging habitat for the pygmy rabbit would be lost. Bat species, such as the Townsend's western big-eared bat, may roost in caves and forage throughout the proposed site. One State-listed sensitive plant species could potentially be affected by construction of the facility. The plant species, tree-like oxytheca, has been collected at eight sites on INEL and at only two other sites in Idaho (IN DOE 1984a:34,36). If present, individual plants of this species could be destroyed during land clearing activities. Preactivity surveys would be completed as appropriate prior to construction to determine the existence of these species in the area to be disturbed.

During operation of the new facility, several bat species could forage at evaporation and stormwater retention ponds. No impacts to threatened and endangered species are expected due to facility operation.

Pantex Plant

It is assumed that the potential site for the evolutionary LWR is located in the northwest portion of Pantex. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of either the large or small evolutionary LWR at Pantex would result in the disturbance of terrestrial habitat equaling about 8.0 percent of the site. Land on which the facility would be built is presently used for agricultural purposes.

Construction of either the large or small evolutionary LWR would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction area and adjacent

areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests of migratory birds and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Areas that would be reestablished as farmland or revegetated upon completion of construction would be recolonized by animal species present in nearby, undisturbed habitats.

Activities associated with facility operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas. Impacts to vegetation from salt drift would not occur since dry cooling towers would be used.

Wetlands. Impacts to wetlands may result from land disturbances and treated wastewater disposal during construction. Construction-related ground disturbance may increase the potential for sediment runoff to the playa wetlands. This impact would be controlled through the implementation of standard soil erosion and sediment control measures. Site playas would be avoided during construction. A small area designated as a pristine wetland on NWI maps is located in the site area. If this area is determined to be a jurisdictional wetland, any potential impacts would be mitigated according to DOE policy set forth in 10 CFR 1022 and in accordance with COE permit requirements.

During construction and operation, treated wastewater would be discharged to the playas. Although part of the discharged water would be lost to the atmosphere due to high evapotranspiration rates, it could cause shifts in the composition of wetland plant communities and increases in the area of open water. The plant community shifts would favor plants tolerant of longer and deeper inundation. Furthermore, disturbed plant communities provide an opportunity for establishment of invasive exotic plant species. The potential for these impacts would be less for a small evolutionary LWR since less water would be discharged to site playas. All wastewater discharges would be treated as necessary to meet NPDES-permit requirements.

Aquatic Resources. Construction and operation of either the large or small evolutionary LWR facility would result in discharges of wastewater to the playas. As discussed for wetlands, the discharges could potentially result in an increase in open water area which would provide some additional aquatic habitat. Playas could also be affected by sediment runoff during construction; however, this impact would be controlled through the use of soil erosion and sediment control measures.

Threatened and Endangered Species. The bald eagle is a consistently occurring federally listed species at Pantex that has the potential to be affected by construction or either the large or small evolutionary LWR. Bald eagles avoid areas where humans are active; thus, wintering eagles observed at Pantex would be disturbed by increased activity.

Several Federal candidate or State-listed species may be affected by construction activities. Similar to the bald eagle, white-faced ibis may be discouraged from foraging at site playas during construction. [Text deleted.] The swift fox would also lose potential foraging and denning habitat. During operation, the swift fox would not use areas in proximity to the operating plant. The Texas horned lizard is less mobile and would be lost during land-clearing activities. Preactivity surveys would be completed, as appropriate, prior to construction to determine the existence of these species in the area to be disturbed. Consultation with USFWS would occur as required and, if necessary, a detailed mitigation plan would be developed.

[Text deleted.]

Oak Ridge Reservation

For analytical purposes it is assumed that either the large or small evolutionary LWR would be located at the former breeder reactor site. Impacts to terrestrial resources, wetlands, aquatics resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Although the assumed evolutionary LWR site is located within an area that has been designated as pine and pine hardwood forest (Figure 3.6.6-1), it was disturbed in the past by clearing and grading activities for the breeder reactor. Presently, the site could be classified as an old field. Construction of evolutionary LWR would result in this area being redisturbed. It is also possible that some undisturbed vegetation, primarily pine and pine hardwood forest, immediately surrounding the site would also be cleared.

Salt drift from wet cooling towers associated with either the large or small evolutionary LWR could cause salt deposition on surrounding land areas and vegetation. At present, the reactor design has not advanced sufficiently to predict the area that could be affected by salt drift at ORR; however, previous studies for a proposed tritium reactor at SRS, which was designed for the southeastern United States, would be expected to be applicable to ORR. The proposed SRS reactor was predicted to impact 5 ha (12 acres) at a deposition rate of 17.1 kg/ha/month (15.2 lb/acre/month) (DOE 1992e:5-213). This is the level at which salt stress symptoms could become evident on sensitive plants. Salt drift impacts which may be associated with either evolutionary LWR option will be evaluated in site-specific NEPA documentation.

Construction of the proposed facility would affect animal populations. Less mobile animals within the proposed project area, such as amphibians, reptiles, and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction area and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Activities associated with facility operation, such as noise and human presence, could affect wildlife living immediately adjacent to the proposed facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Because the majority of the land in the site area is upland, it is expected that direct impacts to wetlands from construction of either a large or small evolutionary LWR could largely be avoided. Minor impacts could occur from the construction of rights-of-way. Indirect impacts to wetlands from stormwater runoff during construction and operation are possible. Impacts on wetlands would not be expected from salt deposition due to the limited area that would likely be affected. It may be necessary to cross wetlands when constructing intake or outfall structures; however, impacts would be temporary. Any unavoidable impacts to wetlands would be mitigated according to DOE policy set forth in 10 CFR 1022 and in accordance with the COE permit requirements.

Construction-related discharges (for example, from foundation dewatering) would be directed to the Clinch River. Discharges to the Clinch River would have minimal impact on the flow of the river and would not be expected to affect associated wetlands.

During operation, blowdown water from the cooling system would also be discharged to the Clinch River. Discharges to the Clinch River, which for the large evolutionary LWR option would represent up to 20 percent

of the flow of the river during each discharge period, could lead to streambed scouring in the vicinity of the outfall and subsequent downstream sedimentation. This could alter wetlands present in the vicinity of the outfall, as well as those located downstream. The use of detention ponds and engineered energy dissipating structures would reduce impacts of discharges. Thermal impacts to wetland vegetation could occur with the release of large volumes of cooling tower blowdown. All wastewater discharges would be treated as necessary to meet NPDES-permit requirements.

Aquatic Resources. Construction of either the large or small evolutionary LWR could cause water quality changes, primarily sediment loading and resulting turbidity, to the Clinch River. These potential impacts would be reduced by implementing a soil erosion and sediment control plan. Construction water withdrawal would represent a very small percentage of the average flow of the Clinch River and, thus, would have little effect on its flow. Impingement and entrainment impacts would, therefore, be minimal and would be unlikely to affect fish populations in the Clinch River. During construction, dewatering discharges would be directed to the Clinch River. Impacts to the river would be expected to be minimal.

During operation, water withdrawals could increase entrainment and impingement of fish in the Clinch River. However, the volume of the water withdrawn for either reactor alternative would comprise a small percentage of the flow of the river and is unlikely to affect fish populations. Further, intake structures would be designed to reduce intake flow rates, thereby reducing impingement and entrainment losses.

Blowdown water from the cooling system of the evolutionary LWR would be released to the Clinch River. Discharge to the river from the large evolutionary LWR would represent about 20 percent of the flow of the river during each discharge period. This could result in streambed scouring in the vicinity of the outfall and subsequent downstream sedimentation. Although fish would likely return to the disturbed area between periods of discharge, this would not be possible for benthic organisms. Thermal impacts may also occur as the result of the release of large intermittent volumes of cooling water. Detention ponds may be necessary to reduce peak flows to the Clinch River. Chemical constituents and temperature of the discharges would be required to meet NPDES permit limits.

Threatened and Endangered Species. It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of either the large or small evolutionary LWR at the former breeding reactor site on ORR. Since this site is located within previously disturbed habitat, there is less potential for impact to special status species. Any special status plant species found in the pine and pine hardwood forest habitat adjacent to the disturbed site area could be destroyed if additional land is required. Prior to development, a survey would be conducted to determine the occurrence of listed plant species. Small, relatively immobile animal species, such as the Allegheny woodrat and southeastern shrew, could be destroyed during land-clearing activities. Preactivity surveys would be conducted as appropriate prior to construction to determine the existence of these and other special status species.

Savannah River Site

It is assumed that either the large or small evolutionary LWR would be constructed just to the northeast of the N-Area. Impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species are discussed below.

Terrestrial Resources. Construction and operation of the evolutionary LWR at SRS would result in the disturbance of terrestrial habitat equaling about 0.4 percent of the site. Since the majority of the site is covered by pine plantations, it is this vegetation type that would be most affected. However, other upland types, such as old-field, and mixed forest and grassland could also be impacted. Bottomland hardwoods and wetlands would be avoided to the extent possible.

Salt drift from wet cooling towers associated with either the large or small evolutionary LWR could cause salt deposition on surrounding land areas and vegetation. At present, the reactor design has not advanced sufficiently to predict the area that could be affected by salt drift at SRS; however, previous studies for a proposed tritium reactor at SRS predicted that 5 ha (12 acres) would be affected at a deposition rate of 17.1 kg/ha/month (15.2 lb/acre/month) (DOE 1992e:4-126). This is the level at which salt stress symptoms could become evident on sensitive plants. Salt drift impacts which may be associated with either evolutionary LWR option will be evaluated in site-specific NEPA documentation.

Construction of an evolutionary LWR would affect animal populations. Less mobile animals, such as amphibians, reptiles, and small mammals, within the project area would not be expected to survive. Construction activities and noise would cause larger mammals and birds to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area was already supporting the maximum number of individuals, the additional animals would compete for limited resources which could lead to habitat degradation and eventual loss of the excess population. Nests of migratory birds and young animals living within the assumed site may not survive. The site would be surveyed as necessary for the nests of migratory birds prior to construction. Upon completion of construction, revegetated areas would be of minimal value to most types of wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area. Disturbance to wildlife living adjacent to the facility would be minimized by preventing workers from entering undisturbed areas.

Wetlands. Since the majority of the assumed evolutionary LWR site is upland, it is expected that direct impacts to wetlands from construction of either reactor alternative could be largely avoided. Implementation of soil erosion and sediment control measures would control secondary impacts. Impacts to wetlands resulting from the construction of intake or outfall structures would be temporary. Any unavoidable impacts to wetlands would be mitigated according to DOE policy set forth in 10 CFR 1022 and in accordance with COE permit requirements. Construction wastewater discharge to Fourmile Branch would be minimal and would not be expected to affect wetlands associated with the stream.

Cooling system blowdown would be directed to either Fourmile Branch or Par Pond. Intermittent discharges of large volumes of water from cooling system blowdown to Fourmile Branch could impact wetlands bordering the stream and the Savannah River Swamp. Sediment build up in the Savannah River Swamp resulting from streambed scouring could result in swamp forest vegetation being replaced by scrub/shrub or emergent vegetation. Also, erosion of stream banks could result in the loss of wetland vegetation. These impacts would be less for the small evolutionary LWR since a smaller discharge volume is involved. The use of detention ponds and engineered energy dissipating structures would reduce impacts of discharges. Thermal impacts to wetlands were not predicted for a previous tritium reactor planned for SRS (DOE 1992e:5-215); such impacts are also not expected for the proposed reactor. All wastewater discharges would be treated as necessary to comply with NPDES-permit requirement.

As an alternative to discharging blowdown water to Fourmile Branch, water from cooling tower blowdown could be discharged to Par Pond via pre-cooling ponds (that is, Pond 2, Pond 5, and Pond C). Makeup water currently is pumped into Par Pond from the Savannah River to maintain its level and the proper rate of flow in Lower Three Runs Creek (DOE 1992e:5-216). If blowdown water from either reactor alternative were sent to Par Pond, no impacts to wetlands would be anticipated since there would be no change in the level of Par Pond or the flow rate of Lower Three Runs Creek.

Aquatic Resources. Stormwater runoff during construction of either the large or small evolutionary LWR could cause temporary water quality changes in Fourmile Branch and Pen Branch. Increased turbidity could impact

some fish spawning and feeding habitat. Fish populations would probably move to less disturbed areas of the stream and recolonize disturbed areas shortly after construction is complete and water quality improves. Construction of intake and discharge facilities would result in the temporary loss of habitat in the affected waterbodies. During construction, wastewater would be discharged to Fourmile Branch. These discharges would be minimal and would not be expected to affect aquatic resources.

During operation of either Evolutionary LWR Alternative, water would be withdrawn from the Savannah River. For both alternatives, the volume of water withdrawn represents a small percentage of the average flow of the river and would not affect its flow. However, an increase in entrainment and impingement of fish could occur. Based on previous studies for a tritium production reactor at SRS (DOE 1992e:5-218) and monitoring of past SRS operations (WSRC 1989e:4-506), fish populations should not be affected by entrainment losses from operation of the evolutionary LWR. Similarly, impingement losses should not impact fish populations. Impacts to anadromous fish (for example, striped bass and several species of shad) due to entrainment and impingement, would also be relatively low and would not affect their populations. In compliance with the *Anadromous Fish Conservation Act*, populations of anadromous fish species would be sustained and their movement unobstructed by project construction and operation.

During operation, blowdown from the cooling system of either the large or small evolutionary LWR would be released to either Fourmile Branch or Par Pond. Impacts would be less for the small evolutionary LWR since it would discharge a smaller volume of water. Intermittent discharges of large volumes of water from blowdown would greatly increase the flow rate of Fourmile Branch which would cause flooding and stream bed scouring. This could alter the aquatic ecosystem by displacing existing plant and animal communities. Previous studies for a tritium production reactor at SRS indicated that water temperatures of discharges were expected to be within the thermal tolerance limits of native warmwater fish species. The temperature of water from blowdown discharges was also expected to be within normal water temperatures of each season and were not expected to alter the distribution or abundance of aquatic organisms in receiving waters. However, the temperature of blowdown water discharged to Fourmile Branch was predicted to exceed the maximum temperature differential of 2.8 °C (7.5 °F) between effluent and receiving stream during the cooler months of the year. Such an exceedance would require a Section 316(a) demonstration of balanced biotic community (DOE 1992e:5-218, 5-219).

Discharge to Par Pond would have no flow impacts since it currently receives makeup water to maintain its level. In fact, projected discharges would reduce the need to pump makeup water to Par Pond. Thermal impacts to Par Pond would not be expected since discharged water would pass through a series of precooling ponds designed to meet the State of South Carolina requirements for thermal releases to Class B waters; however, the recovery of the precooling ponds from past thermal discharges would be affected.

Threatened and Endangered Species. The only federally listed threatened or endangered species that could be affected by construction of either the large or small evolutionary LWR at SRS is the smooth purple coneflower. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the assumed site that this species would not be directly impacted by the reactor. Other special status species that would potentially be impacted by construction activities include the green-fringed orchid, eastern tiger salamander, Florida false loosestrife, beak-rush, star-nosed mole, and Cooper's hawk. If present, individuals of each of these species could be destroyed, except the hawk which could be temporarily displaced during construction.

During operation, there is potential for impacts to the federally listed short nose sturgeon and wood stork. The short nose sturgeon has been observed in the Savannah River where cooling water would be withdrawn. However, sturgeon eggs tend to sink and are strongly adhesive and gelatinous, which limits their downstream transport and dispersal through the water column. Thus, sturgeon eggs do not have a high entrainment risk. The preference of sturgeon larva for benthic habitat and the ability of juvenile and adult sturgeon to attain swimming speeds above the water intake velocity demonstrate the unlikelihood of impingement losses of this species

(DOE 1992e:5-222). Cooling system blowdown discharged to Fourmile Branch from either reactor alternative could cause an increase in stream depth which could disrupt the foraging activities of the wood stork. Preactivity surveys would be conducted as appropriate prior to construction to determine the occurrences of these and other special status species within the construction and water discharge areas. Consultation with USFWS would occur as required and, if necessary, a detailed mitigation plan would be developed.

4.3.5.4.7 Cultural and Paleontological Resources

This section discusses construction and operational impacts to cultural and paleontological resources that may result from the Evolutionary LWR Alternative at each of the representative sites analyzed. Land to be disturbed during construction of the large or small two-unit evolutionary LWR totals 284 ha (700 acres). Construction of a large or small one-unit evolutionary LWR would disturb 142 ha (350 acres). Total land area requirement during operation for the large or small two-unit evolutionary LWR would be 138 ha (340 acres), and increasing the facility to four units (small) would increase operation land area to 227 ha (560 acres). [Text deleted.]

Because there is no difference in plant footprint or land disturbance between the large and small reactors, impacts to cultural and paleontological resources would not differ. For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources at the proposed sites may be affected directly through ground disturbance during construction, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism.

Hanford Site

The evolutionary LWR would be constructed adjacent to the WNP-1 and WNP-2 reactors. An archaeological surface survey was completed in the area of the WNP-1 reactor, including the staging area and pumphouse site, in 1974 and no archaeological sites were identified. However, archaeological monitoring during construction identified historic and prehistoric artifacts (HF WPPSS 1983a:66,68). Prehistoric resources that may occur at Hanford include remains of campsites, burials, and hunting/kill sites. Historic resources may include remains of ranches, homesteads, or trash dumps.

Native American resources potentially affected by the construction and operation of the proposed facility would be identified through consultation with interested parties. Impacts may include disturbance of important Native American plant communities, reduced access to traditional use areas, or visual and audio intrusion into sacred spaces.

Construction may affect some paleontological remains. Pliocene and Late Pleistocene remains have been found in and around Hanford. These remains have high research potential. There would be no additional impacts to paleontological resources from operation as it does not involve additional ground disturbance.

Nevada Test Site

The evolutionary LWR would be constructed in Area 6, near the DAF on Frenchman Flat. In 1984, a Class III cultural resources survey was conducted across the 660-ha (1,610-acre) DAF site, and no NRHP-eligible sites were identified. Although no resources were identified within the DAF project area, Frenchman Flat contains 49 sites which have been determined eligible for inclusion on the NRHP. Recorded prehistoric sites within Frenchman Flat include base and temporary camps, quarries, and lithic reduction areas. Identified historic resources include sites associated with nuclear testing and research. Additional unsurveyed land necessary for the proposed facility may contain similar prehistoric or historic resources. Impacts to resources would occur during construction of the proposed facility. Operation would not result in additional impacts as it does not involve ground disturbance or increased activity.

The CGTO has conducted surveys over portions of Frenchman Flat and identified at least 20 plant species of importance to Native Americans. Additional project-specific consultations would be necessary to identify impacts to Native American resources resulting from the construction and operation of the facility. Potential impacts include reduced access to traditional use areas and visual or auditory intrusions to sacred space.

Although none have been identified to date, Quaternary deposits containing scientifically valuable paleontological remains may occur in the area to be disturbed during construction. Such remains have been found near NTS. Paleontological remains may be affected by construction, but not operation, of the facility.

Idaho National Engineering Laboratory

The facility would be constructed northwest of the PBF in the Central Core Area/Prime Development Land Zone of INEL. This area has been developed and disturbed and the probability of finding NRHP-eligible archaeological sites or paleontological remains is low, but possible. Construction and operation are not expected to have an effect on these resources. Some Native American resources such as traditional use areas and sacred space may be affected by the construction and operation of the facility. Some paleontological remains may be affected by construction. There are 31 known fossil localities at INEL. Operation would not have an additional effect on these resources.

Pantex Plant

The evolutionary LWR would be constructed in the northwest portion of Pantex, west of the burning ground. This area is currently used for agriculture. Some NRHP-eligible resources may be affected by the construction of this facility. Any resources would be identified during the NHPA Section 106 compliance process. There would be no operational impacts to archaeological remains because operation does not involve additional ground disturbance. Construction and operation of these facilities may affect some Native American resources. Native American resources would be identified through project-specific consultation with potentially affected groups. Some paleontological resources may occur in the area to be affected by construction. Operation would not have an additional impact.

Oak Ridge Reservation

This facility would be constructed in the western portion of ORR, south of Bear Creek Road along the Clinch River. A portion of this area was reviewed for archaeological and historic resources as part of the EIS for construction of the proposed Clinch River Breeder Reactor. At that time four historic sites, five archaeological sites, and one cemetery were identified (OR NRC 1977a:2-7). One of the archaeological sites was a prehistoric burial mound. Additional resources may be identified through the NHPA Section 106 compliance process. Construction poses the greatest threat to archaeological resources. Operation would not directly affect these resources.

Construction and operation could have an effect on Native American resources by disturbing traditional plant and animal communities through construction and by reducing access to traditional use areas during operation. These resources could be identified through project-specific consultation with potentially affected tribes.

Paleontological resources could also be affected through new construction, however, those known to occur at ORR are relatively common fossils with low research potential. Operation would not have an impact on these resources.

Savannah River Site

The evolutionary LWR would be located east of the N-Area on undeveloped/forested land previously assessed for the New Production Reactor. This tract contains three NRHP-eligible historic sites. Additional NRHP-eligible resources may occur within unsurveyed areas to be disturbed by construction. Prehistoric site types that may occur at SRS include villages, base camps, limited activity sites, quarries, and workshops. Historic site types that may occur at SRS include cattle ranches, farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farming dikes, cattle pens, dams, towns, churches, cemeteries, trash scatters and roads. In addition, some Native American resources such as remains of villages, traditional plant gathering areas,

cemeteries, and isolated burials may be affected by construction and operation of the facility. No scientifically valuable fossil remains have been recorded at SRS to date. Facility construction and operation are not expected to affect paleontological resources.

| [Text deleted.]

4.3.5.4.8 Socioeconomics

This section analyzes the socioeconomic effects of the Evolutionary LWR for each of the candidate sites. Only the sites with the greatest socioeconomic effects are discussed. The effects at all of the candidate sites are found in the Supplemental Socioeconomic Data Report (Socio 1996a). The large-reactor option will be analyzed in this section because it would have a greater impact on the region than the smaller-reactor option.

Regional Economy Characteristics. Constructing an evolutionary LWR at any of the sites analyzed would generate employment and income increases within the affected REA. Constructing the facility would require 3,500 workers in the peak year of construction at any site. The largest increases in regional employment (about 4 percent) would occur at INEL while the largest increase in regional per capita income (less than 1 percent) would occur at ORR. A total of 7,106 new jobs (3,500 direct and 3,606 indirect) would be generated and regional unemployment would fall from 5.4 to 3.0 percent at INEL (Socio 1996a).

A workforce of 830 would be required to operate the facility at any site. Operating the facility at Pantex would generate the greatest change in regional employment (approximately 1 percent). A total of 3,540 new jobs (830 direct and 2,710 indirect) would be created by the operational activities, and regional unemployment would fall to 3.7 percent. The largest increase in regional per capita income would occur as a result of operating the facility at INEL, but the increase would still be less than 1 percent over No Action (Socio 1996a).

Population and Housing. At all of the sites analyzed, workers would in-migrate to fill some of the newly created positions during both construction and operation. Project-related population increases would be greatest at INEL during construction of the reactor. Population in the ROI would increase by approximately 3 percent during this period. Pantex would require the largest number of in-migrating workers during operation; however, the population increase would be less than 1 percent. During construction, housing units, in excess of existing vacancies, would be required at all of the sites analyzed, except NTS. Additional housing construction would also be required during operation at all of the sites analyzed, except NTS and ORR, to accommodate the in-migrating population. The greatest increase in housing requirements (approximately 3 percent during construction and much less than 1 percent during operation) would be in the INEL ROI. Historic housing construction rates indicate there would be sufficient housing units available to accommodate the in-migrating population at all of the sites analyzed. (Socio 1996a).

Community Services. Constructing an evolutionary LWR would increase demand for community services at all the sites analyzed. The effects of population increases due to in-migrating workers during construction or operation on community services at any of the sites analyzed would be minor. The following discussion focuses on the Pantex and INEL ROIs where the greatest increased demand for community services would occur.

School districts in the Pantex ROI would need an additional 85 teachers during peak construction, and Pantex school districts would also require 21 additional teachers during operations to maintain the Pantex ROI No Action level of service. However, the additional teachers would be distributed over several school districts in the ROI; therefore, no single district would be significantly affected (Socio 1996a).

Twelve additional sworn police officers would be required in the INEL ROI during construction to maintain the No Action service level of 1.6 police officers per 1,000 persons, while 2 additional police officers would be required during operation. Eighteen additional firefighters would be required in the Pantex ROI during construction to maintain the No Action service level of 2.3 firefighters per 1,000 persons, while 3 additional firefighters would be required during operation (Socio 1996a).

Projected hospital occupancy rates during construction and operation would increase slightly over the No Action levels at all the sites analyzed. Projected capacities would be capable of accommodating the increase in patient load. Eleven additional physicians would be needed to maintain the No Action service level of 1.2 physicians

per 1,000 persons in the INEL ROI during construction, while 2 would be needed during operation at Pantex to maintain the No Action service level of 2.0 (Socio 1996a).

Local Transportation. The ORR local transportation network would experience the most noticeable effects from siting the evolutionary LWR. A total of 6,720 and 1,594 vehicle trips per day would be generated during the construction and operation phases, respectively. Vehicle traffic during construction would cause changes in four local road segments. I-275 from I-40 at Knoxville to I-75/640 at Knoxville as well as from I-75 at Knoxville to I-40 would both experience a drop in level of service from D to E. U.S. 70 from U.S. 321 to U.S. 11 would experience a drop in level of service from B to C. Tennessee State Route 58 from Tennessee State Region 95 to I-40 would experience a drop in level of service from E to F. Finally, Tennessee State Route 62 from Tennessee State Route 95 at Oak Ridge to Tennessee State Route at 170 would experience a significant increase in its volume-to-capacity ratio while operating at level of service F.

Drops in level of service for local roads would also occur at Hanford, NTS, INEL, Pantex, and SRS during construction. The INEL local transportation network would experience the most noticeable effects from operations of the evolutionary LWR. One thousand five hundred ninety-four vehicle trips per day would be generated during the operations phase at INEL. US 20 from US 26/91 at Idaho Falls to US 26 East would experience a drop in level of service from D to E. US 20/26 from US 26 East to ID State Route 22/33 would experience a drop in level of service from B to C (Socio 1996a).

4.3.5.4.9 Public and Occupational Health and Safety

This section describes the radiological and hazardous chemical releases and their associated impacts resulting from either normal operation or accidents involved with the evolutionary LWRs. The section first describes the impacts from normal reactor operation at each potential site followed by a description of impacts from reactor accidents. The impacts associated with the ultimate disposal of the spent fuel in a HLW repository are presented separately in technical documents that specifically address repository operations.

Summaries of the radiological impacts to the public associated with normal operation during the assumed 17-year campaign time are presented in Tables 4.3.5.4.9-1 and 4.3.5.4.9-2 for a single large and small evolutionary LWRs, respectively. Summaries of radiological impacts to workers are given in Tables 4.3.5.4.9-3 and 4.3.5.4.9-4 for large and small evolutionary LWRs, respectively. Impacts from hazardous chemicals to these same groups are given in Table 4.3.5.4.9-5. Summaries of impacts associated with postulated accidents are given in Table 4.3.5.4.9-6 through Table 4.3.5.4.9-11. Detailed results are presented in Appendix M.

Normal Operation. There would be no radiological releases associated with the construction of an evolutionary LWR at any of the sites analyzed. Construction worker exposures to material potentially contaminated with radioactivity (for example, from construction activities involved with existing contaminated soil) would be limited to assure that doses are maintained as low as reasonably achievable. Toward this end, construction workers would be monitored as appropriate. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The resulting doses and potential health effects to the public and workers at each site are described below.

Radiological Impacts. Radiological impacts to the average and maximally exposed members of the public resulting from the normal operation of the large and small evolutionary LWRs at each of the sites are presented in Tables 4.3.5.4.9-1 and 4.3.5.4.9-2, respectively. The impacts from all site operations, including the evolutionary LWR, are also given in these tables. To put operational doses into perspective, comparisons with doses from natural background radiation are included in the tables.

The dose to the maximally exposed member of the public from annual large evolutionary LWR operation would range from 0.034 mrem at the NTS site to 4.8 mrem at the ORR site. From 17 years of operation, the corresponding risks of fatal cancer to this individual would range from 2.9×10^{-7} to 4.1×10^{-5} . The impacts to the average individual would be less. As a result of annual operations, the population dose would range from 0.032 person-rem at NTS to 32 person-rem at SRS. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 2.7×10^{-4} to 0.27.

The doses to the maximally exposed member of the public from annual total site operations, including the large evolutionary LWR, are all within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5, and would range from 0.035 mrem at NTS to 6.7 mrem at the ORR site. From 17 years of operation, the corresponding risks of fatal cancers to this individual would range from 3.0×10^{-7} to 5.7×10^{-5} . The impacts to the average individual would be less. This activity would be included in a program to ensure that doses to the public are as ALARA. As a result of annual total site operations, the population doses would be within the limit in proposed 10 CFR 834 and would range from 0.036 person-rem at the NTS site to 76 person-rem at the SRS site. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 3.0×10^{-4} to 0.65.

The dose to the maximally exposed member of the public from annual small evolutionary LWR operation would range from 0.025 mrem at NTS to 2.8 mrem at the ORR site. From 17 years of operation, the corresponding risks of fatal cancer to this individual would range from 2.1×10^{-7} to 2.4×10^{-5} . The impacts to the average

Table 4.3.5.4.9-1. Potential Radiological Impacts to the Public During Normal Operation of the Large Evolutionary
Light Water Reactor

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Reactor	Total Site ^a	Reactor	Total Site ^a	Reactor	Total Site ^a	Reactor	Total Site ^a	Reactor	Total Site ^a	Reactor	Total Site ^a
Annual Dose to the Maximally Exposed Individual Member of the Public^b												
Atmospheric release pathway (mrem)	0.33	0.33	0.034	0.035	0.046	0.053	1.5	1.5	4.8	5.0	0.26	0.61
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0	1.0x10 ⁻³	0.10	4.3x10 ⁻⁴	0.081
Total liquid release pathway (mrem)	0.014	0.015	0	0	0	0	0	0	0.060	1.8	0.015	0.39
Atmospheric and liquid release pathways combined (mrem)	0.34	0.35	0.034	0.035	0.046	0.053	1.5	1.5	4.9	6.7	0.27	1.0
Percent of natural background ^c	0.11	0.12	0.011	0.011	0.014	0.016	0.45	0.45	1.6	2.3	0.092	0.34
17-year fatal cancer risk	2.9x10 ⁻⁶	2.9x10 ⁻⁶	2.9x10 ⁻⁷	3.0x10 ⁻⁷	3.9x10 ⁻⁷	4.5x10 ⁻⁷	1.3x10 ⁻⁵	1.3x10 ⁻⁵	4.1x10 ⁻⁵	5.7x10 ⁻⁵	2.3x10 ⁻⁶	8.5x10 ⁻⁶
Annual Population Dose Within 80 Kilometers^d												
Atmospheric release pathway (person-rem)	30	30	0.032	0.036	9.6	12.0	8.9	8.9	5.1	34	32	72
Total liquid release pathway (person-rem)	1.5	2.6	0	0	0	0	0	0	0.078	4.8	0.096	3.7
Atmospheric and liquid release pathways combined (person-rem)	32	33	0.032	0.036	9.6	12.0	8.9	8.9	5.2	39	32	76
Percent of natural background ^c	0.017	0.018	3.5x10 ⁻⁴	3.9x10 ⁻⁴	0.011	0.013	7.6x10 ⁻³	7.6x10 ⁻³	1.4x10 ⁻³	0.010	0.012	0.029
17-year fatal cancers	0.27	0.28	2.7x10 ⁻⁴	3.0x10 ⁻⁴	0.082	0.10	0.076	0.076	0.044	0.33	0.27	0.65

Table 4.3.5.4.9-1. Potential Radiological Impacts to the Public During Normal Operation of the Large Evolutionary Light Water Reactor—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Reactor	Site ^a	Reactor	Site ^a	Reactor	Site ^a	Reactor	Site ^a	Reactor	Site ^a	Reactor	Site ^a
Annual Dose to the Average Individual Within 80 Kilometer^e												
Atmospheric and liquid release pathways combined (mrem)	0.052	0.053	1.1x10 ⁻³	1.2x10 ⁻³	0.036	0.045	0.025	0.025	4.0x10 ⁻³	0.030	0.036	0.085
17-year fatal cancer risk	4.4x10 ⁻⁷	4.5x10 ⁻⁷	9.3x10 ⁻⁹	1.0x10 ⁻⁸	3.0x10 ⁻⁷	3.8x10 ⁻⁷	2.2x10 ⁻⁷	2.2x10 ⁻⁷	3.4x10 ⁻⁸	2.6x10 ⁻⁷	3.0x10 ⁻⁷	7.2x10 ⁻⁷

^a Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9). The location of the MEL may be different under No Action than for operation of the reactor. Therefore, the impacts may not be directly additive.

^b The applicable radiological limits for an individual member of the public from site operations are 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

^c The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km receives 186,400 person-rem; at NTS is 313 mrem for the average individual; the population within 80 km receives 9,190 person-rem; at INEL is 338 mrem for the average individual; the population within 80 km receives 90,800 person-rem; at Pantex is 334 mrem for the average individual; the population within 80 km receives 116,900 person-rem; at ORR is 295 mrem for the average individual; the population within 80 km receives 379,000 person-rem; at SRS is 298 mrem for the average individual; the population within 80 km receives 266,000 person-rem.

^d For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

^e Obtained by dividing the population dose by the number of people projected to be living within 80 km of the site (621,000 at Hanford; 29,400 at NTS; 269,000 at INEL; 350,000 at Pantex; 1,285,000 at ORR; and 893,000 at SRS).

Source: Section M.2.

Table 4.3.5.4.9-2. Potential Radiological Impacts to the Public During Normal Operation of the Small Evolutionary
Light Water Reactor

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Reactor	Total Site ^a	Reactor	Total Site ^a	Reactor	Total Site ^a	Reactor	Total Site ^a	Reactor	Total Site ^a	Reactor	Total Site ^a
Annual Dose to the Maximally Exposed Individual Member of the Public^b												
Atmospheric release pathway (mrem)	0.23	0.23	0.025	0.026	0.033	0.041	1.0	1.0	2.3	2.5	0.16	0.54
Drinking water pathway (mrem)	0	0	0	0	0	0	0	0	0.011	0.11	4.9x10 ⁻³	0.086
Total liquid release pathway (mrem)	0.024	0.025	0	0	0	0	0	0	0.47	2.2	0.067	0.44
Atmospheric and liquid release pathways combined (mrem)	0.25	0.26	0.025	0.026	0.033	0.041	1.0	1.0	2.8	4.7	0.23	0.98
Percent of natural background ^c	0.085	0.085	8.0x10 ⁻³	8.4x10 ⁻³	9.8x10 ⁻³	0.012	0.30	0.30	0.94	1.6	0.076	0.33
17-year fatal cancer risk	2.1x10 ⁻⁶	2.2x10 ⁻⁶	2.1x10 ⁻⁷	2.2x10 ⁻⁷	2.8x10 ⁻⁷	3.5x10 ⁻⁷	8.5x10 ⁻⁶	8.5x10 ⁻⁶	2.4x10 ⁻⁵	4.0x10 ⁻⁵	1.9x10 ⁻⁶	8.3x10 ⁻⁶
Annual Population Dose Within 80 Kilometers^d												
Atmospheric release pathway (person-rem)	20	20	0.022	0.026	6.9	9.3	7.4	7.4	2.8	32	24	64
Total liquid release pathway (person-rem)	2.6	3.7	0	0	0	0	0	0	0.50	5.2	0.39	4.0
Atmospheric and liquid release pathways combined (person-rem)	23	24	0.022	0.026	6.9	9.3	7.4	7.4	3.3	37	24	68
Percent of natural background ^c	0.012	0.013	2.4x10 ⁻⁴	2.8x10 ⁻⁴	7.6x10 ⁻³	0.010	6.3x10 ⁻³	6.3x10 ⁻³	8.7x10 ⁻⁴	9.8x10 ⁻³	9.2x10 ⁻³	0.026
17-year fatal cancers	0.19	0.20	1.9x10 ⁻⁴	2.2x10 ⁻⁴	0.059	0.079	0.063	0.063	0.028	0.32	0.21	0.58

Table 4.3.5.4.9-2. Potential Radiological Impacts to the Public During Normal Operation of the Small Evolutionary Light Water Reactor—Continued

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Reactor	Site ^a	Reactor	Site ^a	Reactor	Site ^a	Reactor	Site ^a	Reactor	Site ^a	Reactor	Site ^a
Annual Dose to the Average Individual Within 80 Kilometers^c												
Atmospheric and liquid release pathways combined (mrem)	0.037	0.039	7.5×10^{-4}	8.8×10^{-4}	0.026	0.035	0.021	0.021	2.6×10^{-3}	0.029	0.027	0.076
17-year fatal risk	3.1×10^{-7}	3.3×10^{-7}	6.4×10^{-9}	7.5×10^{-9}	2.2×10^{-7}	2.9×10^{-7}	1.8×10^{-7}	1.8×10^{-7}	2.2×10^{-8}	2.4×10^{-7}	2.3×10^{-7}	6.5×10^{-7}

^a Includes impacts from No Action facilities (refer to Sections 4.2.1.9 through 4.2.6.9).

^b The applicable radiological limits for an individual member of the public from site operations are 10 mrem per year from the air pathways, as required by NESHAPS (40 CFR 61, Subpart H) under the CAA; 4 mrem per year from the drinking water pathway, as required by the SDWA; and 100 mrem per year from all pathways combined. Refer to DOE Order 5400.5.

^c The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km receives 186,400 person-rem; at NTS is 313 mrem for the average individual; the population within 80 km receives 9,190 person-rem; at INEL is 338 mrem for the average individual; the population within 80 km receives 90,800 person-rem; at Pantex is 334 mrem for the average individual; the population within 80 km receives 116,900 person-rem; at ORR is 295 mrem for the average individual; the population within 80 km receives 379,000 person-rem; at SRS is 298 mrem for the average individual; the population within 80 km receives 266,000 person-rem.

^d For DOE activities, proposed 10 CFR 834 (see 58 FR 16268) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA program.

[Text deleted.]

^e Obtained by dividing the population dose by the number of people projected to be living within 80 km of the site (621,000 at Hanford; 29,400 at NTS; 269,000 at INEL; 350,000 at Pantex; 1,285,000 at ORR; and 893,000 at SRS).

Source: Section M.2.

individual would be less. The population dose would range from 0.022 person-rem at NTS to 24 person-rem at SRS. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 1.9×10^{-4} to 0.21.

The doses to the maximally exposed member of the public from annual total site operations, including the small evolutionary LWR, are also all within radiological limits and would range from 0.026 mrem at the NTS site to 4.7 mrem at the ORR site. From 17 years of operation, the corresponding risks of fatal cancers to this individual would range from 2.2×10^{-7} to 4.0×10^{-5} . The impacts to the average individual would be less. As a result of annual total site operations, the population doses are also within the proposed reporting limit, and would range from 0.026 person-rem at NTS to 68 person-rem at SRS. The corresponding numbers of fatal cancers in these populations from 17 years of operation would range from 2.2×10^{-4} to 0.58.

Doses to onsite workers from normal operations are given in Tables 4.3.5.4.9-3 and 4.3.5.4.9-4 for the large and small evolutionary LWRs, respectively. Included are involved workers directly associated with the evolutionary LWR, workers who are not involved with the reactor and the entire workforce at each site. All doses fall within regulatory limits.

For the large evolutionary LWR alternative, the annual dose to reactor workers is site-independent and would be 810 mrem to the average worker associated with the evolutionary LWR and 170 person-rem to entire evolutionary LWR workforce. The annual average dose to the noninvolved worker would range from 2.6 mrem at ORR to 32 mrem at SRS. The annual total dose to all noninvolved workers would range from 3.0 person-rem at the NTS site to 250 person-rem at the Hanford site. The annual dose to the total site workforces would range from 173 person-rem at the NTS site to 420 person-rem at the Hanford site.

For the small evolutionary LWR alternative, the annual incremental dose to reactor workers is site-independent and would be 800 mrem to the average worker associated with the evolutionary LWR and 100 person-rem to entire evolutionary LWR workforce. The annual average dose to the noninvolved worker would range from 2.6 mrem at ORR to 32 mrem at SRS. The annual total dose to all noninvolved workers would range from 3.0 person-rem at NTS to 250 person-rem at Hanford. The annual dose to the total site workforces would range from 103 person-rem at NTS to 350 person-rem at Hanford.

The risks and numbers of fatal cancers among the different workers from 17 years of operation are included in Tables 4.3.5.4.9-3 and 4.3.5.4.9-4 for the large and small evolutionary LWRs, respectively. Dose to individual workers would be kept low by instituting badged monitoring and ALARA programs and also worker rotations. As a result of the implementation of these mitigation measures, the actual number of fatal cancers calculated would be lower for the operation of this facility.

Hazardous Chemical Impacts. The hazardous chemical impacts to the public resulting from normal operation of the large and small evolutionary LWR facilities at each of several sites are presented in Table 4.3.5.4.9-5. Included is the impact due only to operation of the evolutionary LWR facilities and the site's total hazardous chemical impact. The total site impacts are provided to demonstrate the estimated level of health effects expected and the risk of cancer due to the total chemical exposures on each site. All supporting impact analyses are provided in Section M.3.

For the large or small evolutionary LWR facilities, exposure data are identical and the HIs to the MEIs range from 2.8×10^{-8} at NTS to 1.1×10^{-6} at ORR and Pantex. The incremental cancer risk from hazardous chemicals to the MEI is 0 at all sites. The HI to the onsite worker ranges from 7.8×10^{-6} at Pantex to 1.6×10^{-5} at the Hanford, INEL, and ORR sites and the cancer risk to the onsite worker is zero (because no carcinogens are released from hazardous chemicals) at all sites.

Table 4.3.5.4.9-3. Potential Radiological Impacts to Workers During Normal Operation of the Large Evolutionary Light Water Reactor

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce^a						
Average worker dose (mrem/yr) ^b	810	810	810	810	810	810
17-year fatal cancer risk	5.5x10 ⁻³	5.5x10 ⁻³	5.5x10 ⁻³	5.5x10 ⁻³	5.5x10 ⁻³	5.5x10 ⁻³
Total dose (person-rem/yr)	170	170	170	170	170	170
17-year fatal cancers	1.2	1.2	1.2	1.2	1.2	1.2
Noninvolved Workforce^c						
Average worker dose (mrem/yr) ^b	27	5.0	30	10	2.6	32
17-year fatal cancer risk	1.8x10 ⁻⁴	3.4x10 ⁻⁵	2.0x10 ⁻⁴	6.8x10 ⁻⁵	1.8x10 ⁻⁵	2.2x10 ⁻⁴
Total dose (person-rem/yr)	250	3.0	220	14	44	226
17-year fatal cancers	1.7	0.020	1.5	0.095	0.30	1.5
Total Site Workforce^d						
Dose (person-rem/yr)	420	173	390	184	214	396
17-year fatal cancers	2.9	1.2	2.7	1.3	1.5	2.7

^a The involved worker is a worker associated with operations of the proposed action.

^b The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992c); the sites must make reasonable attempts to maintain worker doses below this level.

^c The noninvolved worker is a worker onsite but not associated with operations of the proposed action. The noninvolved workforce is equivalent to the No Action workforce.

^d The impact to the total workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

Table 4.3.5.4.9-4. Potential Radiological Impacts to Workers During Normal Operation of the Small Evolutionary
Light Water Reactor

Receptor	Hanford	NTS	INEL	Pantex	ORR	SRS
Involved Workforce^a						
Average worker dose (mrem/yr) ^b	800	800	800	800	800	800
17-year fatal cancer risk	5.4×10^{-3}	5.4×10^{-3}	5.4×10^{-3}	5.4×10^{-3}	5.4×10^{-3}	5.4×10^{-3}
Total dose (person-rem/yr)	100	100	100	100	100	100
17-year fatal cancers	0.68	0.68	0.68	0.68	0.68	0.68
Noninvolved Workforce^c						
Average worker dose (mrem/yr) ^b	27	5.0	30	10	2.6	32
17-year fatal cancer risk	1.8×10^{-4}	3.4×10^{-5}	2.0×10^{-4}	6.8×10^{-5}	1.8×10^{-5}	2.2×10^{-4}
Total dose (person-rem/yr)	250	3.0	220	14	44	226
17-year fatal cancers	1.7	0.020	1.5	0.095	0.30	1.5
Total Site Workforce^d						
Dose (person-rem/yr)	350	103	320	114	144	326
17-year fatal cancers	2.4	0.70	2.2	0.78	0.98	2.2

^a The involved worker is a worker associated with operations of the proposed action.

^b The radiological limit for an individual worker is 5,000 mrem/year (10 CFR 835). However, DOE has also established an administrative control level of 2,000 mrem per year (DOE 1992t); the sites must make reasonable attempts to maintain worker doses below this level.

^c The noninvolved worker is a worker onsite but not associated with operations of the proposed action. The noninvolved workforce is equivalent to the No Action workforce.

^d The impact to the total workforce is the summation of the involved worker impact and the noninvolved worker impact.

[Text deleted.]

Source: Section M.2.

Table 4.3.5.4.9-5. Potential Hazardous Chemical Impacts to the Public and Workers During Normal Operation of the Large or Small Evolutionary Light Water Reactor

Receptor	Hanford		NTS		INEL		Pantex		ORR		SRS	
	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b	Facility ^a	Total Site ^b
Maximally Exposed Individual (Public)												
Hazard index ^c	1.9x10 ⁻⁷	6.2x10 ⁻⁵	2.8x10 ⁻⁸	2.8x10 ⁻⁸	4.1x10 ⁻⁷	0.015	1.1x10 ⁻⁶	5.7x10 ⁻³	1.1x10 ⁻⁶	0.040	5.2x10 ⁻⁸	5.2x10 ⁻³
Cancer risk ^d	0	0	0	0	0	0.036	0	1.1x10 ⁻⁸	0	0	0	1.3x10 ⁻⁷
Worker Onsite												
Hazard index ^e	1.6x10 ⁻⁵	4.0x10 ⁻³	8.0x10 ⁻⁶	8.0x10 ⁻⁶	1.6x10 ⁻⁵	0.22	7.8x10 ⁻⁶	6.1x10 ⁻³	1.6x10 ⁻⁵	0.15	1.4x10 ⁻⁵	1.2
Cancer risk ^f	0	0	0	0	0	7.7x10 ⁻⁴	0	4.5x10 ⁻⁷	0	0	0	1.9x10 ⁻⁴

^a Facility=Contribution from the proposed new facility operation only.

^b Total=Includes the contributions from the No Action and the proposed new facility operation.

^c Hazard Index for MEI=sum of individual Hazard Quotients (noncancer health effects) for MEI.

^d Cancer Risk for MEI=(emissions concentrations) x (0.286 [converts concentrations to doses]) x (Slope Factor).

^e Hazard Index for workers=sum of individual Hazard Quotients (noncancer health effects) for workers.

^f Cancer Risk for workers=(emissions for 8-hr) x (0.286 [converts concentrations to doses]) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (Slope Factor).

Note: Where there are no known carcinogens among the hazardous chemicals emitted, there are no slope factors; therefore, the calculated cancer risk value is 0.

Source: Section M.3, Large Evolutionary LWRs: Tables M.3.4-68 through M.3.4-73 and Small Evolutionary LWRs: Tables M.3.4-74 through M.3.4-79.

Facility Accidents. A set of potential accidents for evolutionary light water reactors for which there may be releases of radioactivity that may impact noninvolved onsite workers and the offsite population has been postulated. The accident consequences and risks to a worker located 1,000 m (3,280 ft) from the accident release point, the maximum offsite individual located at the site boundary, and the population located within 80 km of the accident release point are summarized in Tables 4.3.5.4.9–6 through 4.3.5.4.9–11 for the candidate sites (Hanford, NTS, INEL, Pantex, ORR, and SRS). In the event that the site boundary is less than 1,000 m (3,280 ft) from the accident release point, the worker is placed at the site boundary. For the set of accidents analyzed, the maximum number of cancer fatalities in the population within 80 km (50 mi) would be 22.0 at ORR for the large break loss of coolant and loss of core cooling accident scenario with a probability of 2.1×10^{-8} per year. The corresponding 17 year facility lifetime risk from the same accident scenario for the population, maximum offsite individual, and worker at 665 m (2,200 ft) would be 7.9×10^{-6} , 2.6×10^{-8} , and 2.1×10^{-8} , respectively. Appendix M.5 presents summary descriptions of the accident scenarios identified in Tables 4.3.5.4.9–6 through 4.3.5.4.9–11.

[Text deleted.] The location of workstations, number of workers, personnel protective features, engineered safety features, and other design details affect the extent of worker exposures to accidents. Certain accidents such as fires and explosions could cause fatalities to workers close to the accident. Prior to construction and operation of a new facility, DOE Orders require detailed safety analyses to assure that facility designs and operating procedures limit the number of workers in hazardous areas and minimize risk of injury or fatality in the event of an accident.

Aircraft Crash. The probability of an aircraft crash into a new disposition facility at Pantex will depend upon its specific location relative to the airport and airplane traffic patterns. In the future, there is the possibility that air traffic patterns may change and cause a change in the probability of a crash into a specific facility. [Text deleted.] A discussion of aircraft crash accidents for this PEIS is contained in Appendix R.

Table 4.3.5.4.9-6. Evolutionary Light Water Reactor Accident Impacts at Hanford Site

Accident Description	Worker at 1,000 m			Maximum Offsite Individual			Population to 80 km		
	Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Probability of Latent Cancer/Prompt Fatality ^b	Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Probability of Latent Cancer/Prompt Fatality ^b	Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Probability of Latent Cancer/Prompt Fatality ^b	Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Number of Latent Cancer/Prompt Fatalities ^c	Accident Frequency (per yr)
Failure of small primary coolant line outside containment	$3.8 \times 10^{-8}/0$	$2.2 \times 10^{-6}/0$	$4.8 \times 10^{-9}/0$	$2.8 \times 10^{-7}/0$	$8.9 \times 10^{-7}/0$	$5.2 \times 10^{-5}/0$	1.0×10^{-3}		
Scram system piping break outside containment	$4.2 \times 10^{-9}/0$	$2.5 \times 10^{-5}/0$	$5.3 \times 10^{-10}/0$	$3.1 \times 10^{-6}/0$	$9.4 \times 10^{-8}/0$	$5.5 \times 10^{-4}/0$	1.0×10^{-5}		
Cleanup water line break outside containment	$1.1 \times 10^{-10}/0$	$6.7 \times 10^{-7}/0$	$1.4 \times 10^{-11}/0$	$8.4 \times 10^{-8}/0$	$3.1 \times 10^{-9}/0$	$1.8 \times 10^{-5}/0$	1.0×10^{-5}		
Fuel handling	$4.8 \times 10^{-9}/0$	$2.8 \times 10^{-5}/0$	$7.3 \times 10^{-10}/0$	$4.3 \times 10^{-6}/0$	$1.7 \times 10^{-7}/0$	$1.0 \times 10^{-3}/0$	1.0×10^{-5}		
Anticipated transient with scram and loss of core cooling	$4.7 \times 10^{-8}/0$	$0.021/0$	$5.9 \times 10^{-9}/0$	$2.7 \times 10^{-3}/0$	$1.8 \times 10^{-6}/0$	$0.82/0$	1.7×10^{-7}		
Large break loss of coolant accident and loss of core cooling	$3.2 \times 10^{-8}/1.4 \times 10^{-7}$	$0.089/0.040$	$2.9 \times 10^{-8}/3.5 \times 10^{-9}$	$0.082/9.7 \times 10^{-3}$	$2.1 \times 10^{-6}/0$	$5.9/0$	2.1×10^{-8}		
Expected risk ^d	$1.3 \times 10^{-7}/1.4 \times 10^{-7}$	$-$	$4.1 \times 10^{-8}/3.5 \times 10^{-9}$	$-$	$5.1 \times 10^{-6}/0$	$-$	$-$		

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of year of operation.

^b Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1-1 and M.5.3.8.1-2 and the MACCS computer code.

Table 4.3.5.4.9-7. Evolutionary Light Water Reactor Accident Impacts at Nevada Test Site

Accident Description	Worker at 1,000 m			Maximum Offsite Individual			Population to 80 km		
	Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Probability of Latent Cancer/Prompt Fatality ^b	Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Probability of Latent Cancer/Prompt Fatality ^b	Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Probability of Latent Cancer/Prompt Fatality ^b	Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Number of Latent Cancer/Prompt Fatalities ^c	Accident Frequency (per yr)
Failure of small primary coolant line outside containment	$2.7 \times 10^{-8}/0$	$1.6 \times 10^{-6}/0$	$7.0 \times 10^{-10}/0$	$4.1 \times 10^{-8}/0$	$2.7 \times 10^{-8}/0$	$1.6 \times 10^{-6}/0$	$1.6 \times 10^{-6}/0$	$1.6 \times 10^{-6}/0$	1.0×10^{-3}
Scram system piping break outside containment	$2.9 \times 10^{-9}/0$	$1.7 \times 10^{-5}/0$	$7.7 \times 10^{-11}/0$	$4.5 \times 10^{-7}/0$	$2.8 \times 10^{-9}/0$	$1.7 \times 10^{-5}/0$	$2.8 \times 10^{-9}/0$	$1.7 \times 10^{-5}/0$	1.0×10^{-5}
Cleanup water line break outside containment	$7.9 \times 10^{-11}/0$	$4.6 \times 10^{-7}/0$	$2.1 \times 10^{-12}/0$	$1.2 \times 10^{-8}/0$	$9.6 \times 10^{-11}/0$	$5.6 \times 10^{-7}/0$	$9.6 \times 10^{-11}/0$	$5.6 \times 10^{-7}/0$	1.0×10^{-5}
Fuel handling	$3.3 \times 10^{-9}/0$	$1.9 \times 10^{-5}/0$	$1.3 \times 10^{-10}/0$	$7.6 \times 10^{-7}/0$	$4.3 \times 10^{-9}/0$	$2.6 \times 10^{-5}/0$	$4.3 \times 10^{-9}/0$	$2.6 \times 10^{-5}/0$	1.0×10^{-5}
Anticipated transient with scram and loss of core cooling	$3.0 \times 10^{-8}/0$	$0.014/0$	$1.1 \times 10^{-9}/0$	$5.0 \times 10^{-4}/0$	$5.6 \times 10^{-8}/0$	$0.026/0$	$5.6 \times 10^{-8}/0$	$0.026/0$	1.3×10^{-7}
Large break loss of coolant accident and loss of core cooling	$3.1 \times 10^{-8}/8.9 \times 10^{-8}$	$0.087/0.25$	$5.4 \times 10^{-9}/8.4 \times 10^{-11}$	$0.015/2.4 \times 10^{-4}$	$2.1 \times 10^{-8}/0$	$0.059/0$	$2.1 \times 10^{-8}/0$	$0.059/0$	2.1×10^{-8}
Expected risk ^d	$9.4 \times 10^{-8}/8.9 \times 10^{-8}$	$-/-$	$7.4 \times 10^{-9}/8.4 \times 10^{-11}$	$-/-$	$1.1 \times 10^{-7}/0$	$-/-$	$1.1 \times 10^{-7}/0$	$-/-$	$-$

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of year of operation.

^b Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1-1 and M.5.3.8.1-2 and the MACCS computer code.

Table 4.3.5.4.9–8. Evolutionary Light Water Reactor Accident Impacts at Idaho National Engineering Laboratory

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Latent Cancer/Prompt Fatality		Probability of Latent Cancer/Prompt Fatality ^b		Risk of Latent Cancer/Prompt Fatality	
	(per 17 yr) ^a	(per 17 yr) ^a	(per 17 yr) ^a	(per 17 yr) ^a	(per 17 yr) ^a	(per 17 yr) ^a
Failure of small primary coolant line outside containment	3.8x10 ⁻⁸ / 0	2.2x10 ⁻⁶ / 0	4.3x10 ⁻¹⁰ / 0	2.5x10 ⁻⁸ / 0	3.7x10 ⁻⁷ / 0	2.2x10 ⁻⁵ / 0
Scram system piping break outside containment	4.1x10 ⁻⁹ / 0	2.4x10 ⁻⁵ / 0	4.6x10 ⁻¹¹ / 0	2.7x10 ⁻⁷ / 0	3.8x10 ⁻⁸ / 0	2.3x10 ⁻⁴ / 0
Cleanup water line break outside containment	1.1x10 ⁻¹⁰ / 0	6.6x10 ⁻⁷ / 0	1.3x10 ⁻¹² / 0	7.6x10 ⁻⁹ / 0	1.3x10 ⁻⁹ / 0	7.6x10 ⁻⁶ / 0
Fuel handling	4.7x10 ⁻⁹ / 0	2.7x10 ⁻⁵ / 0	8.7x10 ⁻¹¹ / 0	5.1x10 ⁻⁷ / 0	5.5x10 ⁻⁸ / 0	3.3x10 ⁻⁴ / 0
Anticipated transient with scram and loss of core cooling	4.4x10 ⁻⁸ / 0	0.020/ 0	7.3x10 ⁻¹⁰ / 0	3.3x10 ⁻⁴ / 0	7.6x10 ⁻⁷ / 0	0.34/ 0
Large break loss of coolant accident and loss of core cooling	2.5x10 ⁻⁸ / 1.3x10 ⁻⁷	0.071/ 0.36	3.7x10 ⁻⁹ / 0	0.010/ 0	2.0x10 ⁻⁷ / 0	0.57/ 0
Expected risk ^d	1.2x10 ⁻⁷ / 1.3x10 ⁻⁷	–	5.0x10 ⁻⁹ / 0	–	1.4x10 ⁻⁶ / 0	–

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of year of operation.

^b Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1–1 and M.5.3.8.1–2 and the MACCS computer code.

Table 4.3.5.4.9-9. Evolutionary Light Water Reactor Accident Impacts at Pantex Plant

Accident Description	Worker at 1,000 m			Maximum Offsite Individual			Population to 80 km		
	Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Probability of Latent Cancer/ Prompt Fatality ^b		Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Probability of Latent Cancer/ Prompt Fatality ^b		Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Number of Latent Cancer/ Prompt Fatalities ^c	
									Accident Frequency (per yr)
Failure of small primary coolant line outside containment	1.5×10^{-8} / 0	8.8×10^{-7} / 0		1.3×10^{-8} / 0	7.9×10^{-7} / 0		5.4×10^{-7} / 0	3.2×10^{-5} / 0	1.0×10^{-3}
Scram system piping break outside containment	1.6×10^{-9} / 0	9.7×10^{-6} / 0		1.5×10^{-9} / 0	8.7×10^{-6} / 0		5.7×10^{-8} / 0	3.4×10^{-4} / 0	1.0×10^{-5}
Cleanup water line break outside containment	4.5×10^{-11} / 0	2.6×10^{-7} / 0		4.0×10^{-11} / 0	2.3×10^{-7} / 0		1.8×10^{-9} / 0	1.1×10^{-5} / 0	1.0×10^{-5}
Fuel handling	1.9×10^{-9} / 0	1.1×10^{-5} / 0		1.7×10^{-9} / 0	9.9×10^{-6} / 0		8.3×10^{-8} / 0	4.9×10^{-4} / 0	1.0×10^{-5}
Anticipated transient with scram and loss of core cooling	1.6×10^{-8} / 0	7.2×10^{-3} / 0		1.4×10^{-8} / 0	6.5×10^{-3} / 0		9.0×10^{-7} / 0	0.41 / 0	1.3×10^{-7}
Large break loss of coolant accident and loss of core cooling	3.4×10^{-8} / 2.9×10^{-8}	0.095 / 0.080		3.6×10^{-8} / 1.7×10^{-8}	0.10 / 0.047		8.4×10^{-7} / 0	2.3 / 0	2.1×10^{-8}
Expected risk ^d	6.8×10^{-8} / 2.9×10^{-8}	—		6.7×10^{-8} / 1.7×10^{-8}	—		2.4×10^{-6} / 0	—	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of year of operation.

^b Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1-1 and M.5.3.8.1-2 and the MACCS computer code.

Table 4.3.5.4.9-10. Evolutionary Light Water Reactor Accident Impacts at Oak Ridge Reservation

Accident Description	Worker at 665 m			Maximum Offsite Individual			Population to 80 km		
	Probability of			Probability of			Number of		
	Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Latent Cancer/Prompt Fatality ^b	Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Latent Cancer/Prompt Fatality ^b	Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Risk of Latent Cancer/Prompt Fatality (per 17 yr) ^a	Latent Cancer/Prompt Fatalities ^c	Accident Frequency (per yr)
Failure of small primary coolant line outside containment	4.7x10 ⁻⁸ / 0	2.8x10 ⁻⁶ / 0	5.9x10 ⁻⁸ / 0	3.5x10 ⁻⁶ / 0	3.7x10 ⁻⁶ / 0	2.2x10 ⁻⁴ / 0	1.0x10 ⁻³		
Scram system piping break outside containment	5.2x10 ⁻⁹ / 0	3.0x10 ⁻⁵ / 0	6.4x10 ⁻⁹ / 0	3.8x10 ⁻⁵ / 0	3.9x10 ⁻⁷ / 0	2.3x10 ⁻³ / 0	1.0x10 ⁻⁵		
Cleanup water line break outside containment	1.4x10 ⁻¹⁰ / 0	8.3x10 ⁻⁷ / 0	1.8x10 ⁻¹⁰ / 0	1.0x10 ⁻⁶ / 0	1.3x10 ⁻⁸ / 0	7.4x10 ⁻⁵ / 0	1.0x10 ⁻⁵		
Fuel handling	5.8x10 ⁻⁹ / 0	3.4x10 ⁻⁵ / 0	7.3x10 ⁻⁹ / 0	4.3x10 ⁻⁵ / 0	6.6x10 ⁻⁷ / 0	3.9x10 ⁻³ / 0	1.0x10 ⁻⁵		
Anticipated transient with scram and loss of core cooling	6.1x10 ⁻⁸ / 0	0.028/ 0	7.7x10 ⁻⁸ / 0	0.035/ 0	6.9x10 ⁻⁶ / 0	3.1/ 0	1.3x10 ⁻⁷		
Large break loss of coolant accident and loss of core cooling	2.1x10 ⁻⁸ / 2.0x10 ⁻⁷	0.058/ 0.56	2.6x10 ⁻⁸ / 2.0x10 ⁻⁷	0.073/ 0.56	7.9x10 ⁻⁶ / 0	22/ 0	2.1x10 ⁻⁸		
Expected risk ^d	1.4x10 ⁻⁷ / 2.0x10 ⁻⁷	-	1.8x10 ⁻⁷ / 2.0x10 ⁻⁷	-	2.0x10 ⁻⁵ / 0	-	-		

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 665 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of year of operation.

^b Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary [665 m for the facility at ORR], whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1-1 and M.5.3.8.1-2 and the MACCS computer code.

Table 4.3.5.4.9-11. Evolutionary Light Water Reactor Accident Impacts at Savannah River Site

Accident Description	Worker at 1,000 m		Maximum Offsite Individual		Population to 80 km	
	Risk of Latent Cancer/Prompt Fatality		Probability of Latent Cancer/Prompt Fatality ^b		Risk of Latent Cancer/Prompt Fatality	
	(per 17 yr) ^a	(per 17 yr) ^a	(per 17 yr) ^a	(per 17 yr) ^a	(per 17 yr) ^a	(per 17 yr) ^a
Failure of small primary coolant line outside containment	2.4x10 ⁻⁸ / 0	1.4x10 ⁻⁶ / 0	3.5x10 ⁻¹⁰ / 0	2.1x10 ⁻⁸ / 0	1.3x10 ⁻⁶ / 0	7.5x10 ⁻⁵ / 0
Sram system piping break outside containment	2.6x10 ⁻⁹ / 0	1.6x10 ⁻⁵ / 0	3.8x10 ⁻¹¹ / 0	2.3x10 ⁻⁷ / 0	1.3x10 ⁻⁷ / 0	7.9x10 ⁻⁴ / 0
Cleanup water line break outside containment	7.2x10 ⁻¹¹ / 0	4.2x10 ⁻⁷ / 0	1.1x10 ⁻¹² / 0	6.3x10 ⁻⁹ / 0	4.5x10 ⁻⁹ / 0	2.6x10 ⁻⁵ / 0
Fuel handling	3.0x10 ⁻⁹ / 0	1.8x10 ⁻⁵ / 0	6.6x10 ⁻¹¹ / 0	3.9x10 ⁻⁷ / 0	2.1x10 ⁻⁷ / 0	1.3x10 ⁻³ / 0
Anticipated transient with scram and loss of core cooling	3.0x10 ⁻⁸ / 0	0.013/ 0	5.8x10 ⁻¹⁰ / 0	2.6x10 ⁻⁴ / 0	2.5x10 ⁻⁶ / 0	1.1/ 0
Large break loss of coolant accident and loss of core cooling	3.4x10 ⁻⁸ / 7.4x10 ⁻⁸	0.096/ 0.21	1.7x10 ⁻⁹ / 0	4.9x10 ⁻³ / 0	1.5x10 ⁻⁶ / 0	4.3/ 0
Expected risk ^d	9.3x10 ⁻⁸ / 7.4x10 ⁻⁸	—	2.8x10 ⁻⁹ / 0	—	5.7x10 ⁻⁶ / 0	—

^a The risk values are calculated by multiplying the probability of cancer fatality (for the worker at 1,000 m or the maximum offsite individual) or the number of cancer fatalities (for the population to 80 km) by the accident frequency and the number of year of operation.

^b Increase likelihood (or probability) of cancer or prompt fatality to a hypothetical individual (a single onsite worker at a distance of 1,000 m or the site boundary, whichever is smaller, or to a hypothetical individual in the offsite population located at the site boundary) if exposed to the indicated dose. The value assumes the accident has occurred.

^c Estimated number of cancer fatalities in the entire offsite population out to a distance of 80 km if exposed to the indicated dose. The value assumes the accident has occurred.

^d Expected risk is the sum of the risks over the lifetime of the facility.

Note: All values are mean values. Advanced BWR data was used as surrogate data for the evolutionary LWR.

Source: Calculated using the source terms in Tables M.5.3.8.1-1 and M.5.3.8.1-2 and the MACCS computer code.

4.3.5.4.10 Waste Management

This section summarizes the waste management impacts for the construction and operation of a new single unit large or small evolutionary LWR. There are no high-level or TRU wastes associated with the operation of a large or small evolutionary LWR. Tables 4.3.5.4.10-1 and 4.3.5.4.10-2 provide the estimated operational waste volumes projected to be generated at the sites analyzed as a result of a large or small evolutionary LWR. Facilities that would support the evolutionary LWR would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of RCRA and other applicable statutes. Depending in part on decisions in waste-type-specific RODs for the Waste Management PEIS, wastes could be treated, and depending on the type of waste, disposed of onsite or at regionalized or centralized DOE sites. For the purposes of analyses only, this PEIS assumes that TRU and mixed TRU waste would be treated on-site to the current planning-basis WIPP WAC, and shipped to WIPP for disposal. This PEIS also assumes that LLW, mixed LLW, hazardous, and nonhazardous waste would be treated and disposed of in accordance with current site practice. The incremental waste volumes generated from the evolutionary LWR and the resultant waste effluent used for the waste impacts can be found in Section E.3.3.7. A detailed description of the waste management activities that would be required to support the evolutionary LWR can also be found in Section E.3.3.7.

Construction and operation of a large or small evolutionary LWR would impact existing waste management activities at each of the sites analyzed, increasing the generation of spent nuclear fuel, low-level, mixed, hazardous, and nonhazardous wastes. Wastes generated during construction would consist of wastewater, and solid nonhazardous and hazardous wastes. The nonhazardous waste would be disposed of as part of the construction project by the contractor and the hazardous waste would be shipped to commercial RCRA-permitted treatment and disposal facilities. No soil contaminated with hazardous or radioactive constituents is expected to be generated during construction. However, if any contaminated soil is generated it would be managed in accordance with site practice and all applicable Federal and State regulations.

A new large or small evolutionary LWR would generate 10 m^3 (13 yd^3) or 5 m^3 (6.5 yd^3) of spent nuclear fuel annually per unit, resulting in impacts associated with spent nuclear fuel management and storage. The total residual heavy metal content for the entire disposition mission is estimated to be 1,300 t (1,430 tons) for the large reactor and 1,200 t (1,320 tons) for the small reactor. NTS and Pantex do not possess existing inventories of spent nuclear fuel. These sites would need to develop the necessary storage infrastructure for safe and efficient management of spent nuclear fuel. Hanford, INEL, ORR, and SRS each possess existing inventories of spent nuclear fuel, and both INEL and SRS will receive additional spent nuclear fuel from other offsite locations. The sites with existing inventories of spent nuclear fuel may or may not have adequate existing or planned facilities that could manage the additional spent nuclear fuel until a decision regarding its ultimate disposition is made and implemented.

For the large evolutionary LWR at wet or dry sites, following treatment and volume reduction, approximately 70 m^3 (92 yd^3) per reactor of LLW from solidified liquid LLW (from primary and secondary coolant systems, spent fuel pools, and laboratory operations), protective clothing, soil, and small equipment would require disposal annually. All of the sites analyzed except Pantex have existing or planned facilities that could manage the quantities of LLW. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.008 ha/yr (0.02 acre/yr) for SRS, 0.01 ha/yr (0.03 acre/yr) for INEL and NTS, and 0.02 ha/yr (0.05 acre/yr) for Hanford and ORR. With no onsite LLW disposal capability, Pantex would require 5 additional LLW shipments per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD(s) from the Waste Management PEIS.

For the small evolutionary LWR at wet or dry sites, following treatment and volume reduction, approximately 40 m^3 (52 yd^3) per reactor of LLW from solidified liquid LLW, protective clothing, soil, and small equipment would require disposal annually. Using the land usage factors from Section E.1.4, the area required for LLW disposal would be 0.005 ha/yr (0.01 acre/yr) for SRS, 0.006 ha/yr (0.02 acre/yr) for INEL and NTS, and

Table 4.3.5.4.10-1. Estimated Annual Generated Spent Nuclear Fuel and Waste Volumes for the Large Evolutionary
Light Water Reactor^a

Category	Hanford		NTS		INEL		Pantex		ORR		SRS	
	New Facility (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)	No Action (m ³)
Spent Nuclear Fuel	10 ^b	None	None	None (offsite receipts expected)	None	None	None	None	None	None	None (offsite receipts expected)	None
Low-Level												
Liquid	18,900 ^c	None	Dependent on restoration activities	None	None	1	2,970	74,000				
Solid	500	3,390	15,000	7,200	19	7,320	16,400					
Mixed Low-Level												
Liquid	0	3,760	None	4	<1	87,600	1,330					
Solid	5	1,510	50	170	4	432	7,700					
Hazardous												
Liquid	Included in solid	Included in solid	Included in solid	Included in solid	2	6,460	1,260					
Solid	27	560	212	1,200	31	26	15,100					
Non-hazardous (Sanitary)												
Liquid	^d	414,000	Not reported separately, included in solid	Not reported separately, included in solid	141,000	550,000	703,000					
Solid	5,280	5,107	2,120	52,000	339	53,100	61,200					
Non-hazardous (Other)												
Liquid	Included in sanitary	Included in sanitary	None	None	Included in sanitary	650,000	Included in sanitary					
Solid	4,430 ^e	Included in sanitary	76,500	Included in sanitary	Included in sanitary	321	Included in sanitary					

^a The No Action volumes are from Tables 4.2.1.10-1, 4.2.2.10-1, 4.2.3.10-1, 4.2.4.10-1, 4.2.5.10-1, and 4.2.6.10-1. Incremental waste generation volumes for evolutionary LWR (large) are derived from Table E.3.3.7-1 and are for one reactor. Waste effluent volumes (that is, after treatment and volume reduction) that are used in the narrative description of the impacts are also provided in Table E.3.3.7-1.

^b Spent nuclear fuel per unit. Total spent fuel for disposition mission (2 units) is 337 m³. Residual heavy metal content in spent nuclear fuel is 38.2 t per reactor per year.

^c Liquid LLW would be treated and solidified prior to disposal.

^d For wet sites (Hanford, ORR, and SRS) the liquid nonhazardous waste generation is 23,900,000 m³ and for dry sites (NTS, INEL, and Pantex) it is 342,000 m³.

^e Recyclable wastes.

Table 4.3.5.4.10-2. Estimated Annual Generated Spent Nuclear Fuel and Waste Volumes for the Small Evolutionary Light Water Reactor^a

Category	New Facility (m ³)	Hanford		NTS		INEL		Pantex		ORR		SRS	
		No Action (m ³)	Action (m ³)	No Action (m ³)	Action (m ³)	No Action (m ³)	Action (m ³)	No Action (m ³)	Action (m ³)	No Action (m ³)	Action (m ³)	No Action (m ³)	Action (m ³)
Spent Nuclear Fuel	5 ^b	None	None	None	None	None (offsite receipts expected)	None	None	None	None	None	None (offsite receipts expected)	None
Low-Level													
Liquid	2,990 ^c	None	None	Dependent on restoration activities	None	None	None	8	None	2,970	None	74,000	74,000
Solid	270	3,390	None	15,000	None	7,200	None	32	None	7,320	None	16,400	16,400
Mixed Low-Level													
Liquid	0	3,760	None	None	None	4	None	4	None	87,600	None	1,330	1,330
Solid	5	1,510	None	50	None	170	None	46	None	432	None	7,700	7,700
Hazardous													
Liquid	Included in solid	Included in solid	Included in solid	Included in solid	Included in solid	Included in solid	Included in solid	2	None	6,460	None	1,260	1,260
Solid	27	560	None	212	None	1,200	None	31	None	26	None	15,100	15,100
Nonhazardous (sanitary)													
Liquid	^d	414,000	None	Not reported separately, included in solid	Not reported separately, included in solid	Not reported separately, included in solid	Not reported separately, included in solid	141,000	None	550,000	None	703,000	703,000
Solid	3,210	5,107	None	2,120	None	52,000	None	339	None	53,100	None	61,200	61,200
Nonhazardous (Other)													
Liquid	Included in sanitary	Included in sanitary	None	None	None	None	None	Included in sanitary	None	650,000	None	Included in sanitary	Included in sanitary
Solid	2,680 ^e	Included in sanitary	Included in sanitary	76,500	None	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	321	None	Included in sanitary	Included in sanitary

^a The No Action volumes are from Tables 4.2.1.10-1, 4.2.2.10-1, 4.2.3.10-1, 4.2.4.10-1, 4.2.5.10-1, and 4.2.6.10-1. Incremental waste generation volumes for evolutionary LWR (small) are from Table E.3.3.7-2 and are for one reactor. Waste effluent volumes (that is, after treatment and volume reduction) that are used in the narrative description of the impacts are also provided in Table E.3.3.7-2.

^b Spent nuclear fuel per unit. Total spent fuel for disposition mission (4 units) is 338 m³. Residual heavy metal content in spent nuclear fuel is 17.7 t per reactor per year.

^c Liquid LLW would be treated and solidified prior to disposal.

^d For wet sites (Hanford, ORR, and SRS) the liquid nonhazardous waste generation is 11,000,000 m³ and for dry sites (NTS, INEL, and Pantex) it is 190,000 m³.

^e Recyclable wastes.

0.01 ha/yr (0.03 acre/yr) for Hanford and ORR. With no onsite LLW disposal capability, Pantex would require three additional LLW shipments per year to NTS. The ultimate disposal of LLW will be in accordance with the ROD from the Waste Management PEIS.

An estimated 5 m^3 (7 yd^3) of solid mixed LLW per reactor consisting of solvent rags and equipment that has been contaminated with both radioactive and hazardous constituents would require treatment to meet the land disposal restrictions of RCRA. Mixed LLW would be managed in accordance with the Tri-Party Agreement for Hanford and the respective site treatment plan that was developed to comply with the *Federal Facility Compliance Act* for the remainder of the sites analyzed.

Approximately 27 m^3 (35 yd^3) of hazardous waste would consist primarily of analytical solutions and solvent rags contaminated with methylene chloride, acetonitrile, and acetone. Other hazardous waste would include paint solvents, various laboratory chemicals, and organic waste from nonradioactive testing. Hazardous waste would be stored in RCRA-permitted facilities until sufficient quantity accumulated to warrant shipment to a RCRA-permitted treatment and disposal facility.

For the large evolutionary LWR (wet site), approximately 23.9 million m^3 (6.32 billion gal) of liquid nonhazardous sanitary and industrial wastewater, cooling tower blowdown, and estimated stormwater runoff per reactor would require treatment in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems would be required at Hanford, ORR, or SRS. At Hanford, only cooling tower blowdown would be discharged. All other wastewater would be recycled. For the large evolutionary LWR (dry site), approximately 342,000 m^3 (90.3 million gal) of liquid nonhazardous sanitary and industrial wastewater, and estimated stormwater runoff per reactor would require treatment in accordance with site practice and discharge permits. Construction of, or major upgrades to, sanitary, utility, and process wastewater treatment systems would be required at NTS, INEL, and Pantex. After volume reduction, 1,760 m^3 (2,300 yd^3) of solid nonhazardous wastes per reactor such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

For the small evolutionary LWR (wet site), approximately 11 million m^3 (2.91 billion gal) of liquid nonhazardous sanitary and industrial wastewater, cooling tower blowdown, and estimated stormwater runoff per reactor would require treatment in accordance with site practice and discharge permits. Construction of sanitary, utility, and process wastewater treatment systems would be required at Hanford, ORR, or SRS. At Hanford, only cooling tower blowdown would be discharged. All other wastewater would be recycled. For the small evolutionary LWR (dry site), approximately 190,000 m^3 (50.2 million gal) of liquid nonhazardous sanitary and industrial wastewater, and estimated stormwater runoff per reactor would require treatment in accordance with site practice and discharge permits. Construction of, or major upgrades to, sanitary, utility, and process wastewater treatment systems would be required at NTS, INEL, and Pantex. After volume reduction, 1,070 m^3 (1,400 yd^3) of solid nonhazardous wastes per reactor such as paper, glass, discarded office material, and cafeteria waste that is not recycled or salvageable would be shipped to an onsite or offsite landfill in accordance with site-specific practice.

4.4 INTERSITE TRANSPORTATION OF FISSILE MATERIALS

For the storage and disposition alternatives, intersite transportation is the transport between sites with fissile and other radioactive materials (including waste) in truckload shipments by DOE SST or commercial conveyance. For overseas shipments of Pu to European fuel fabricators, port handling and ocean transport is included. [Text deleted.] Supporting analyses and information are contained in Appendix G. Intrastate transportation of pits between Zone 4 and Zone 12 at Pantex to support storage of RFETS pits for the Preferred Alternative is described in Appendix Q.

4.4.1 METHODOLOGY

The analysis for the storage and disposition alternatives evaluates the potential risks from transporting shippable forms of fissile materials (Pu and HEU) that have been stabilized and packaged for shipment at the originating site to meet DOT, NRC, and DOE requirements. Baseline information, the existing transportation serving each site, and the types of containers required for shipment of the materials are included in the analysis, as appropriate.

Actual and projected inventories provided by DOE were used for the transportation risk analysis. The health impacts from the transport of materials were estimated using an assumed homogeneous population along specific routes when sites were known, or along an assumed route distribution of 84 percent rural, 15 percent suburban, and 1 percent urban for generic sites; average container, truckload, or rail carload of material; and a unit measure for traffic fatalities (the risk per kilometer). The assessment provides the total potential fatalities over the life of the project for a comparison of transportation impacts for the alternatives considered.

The analysis to estimate health risks in terms of potential total fatalities due to transportation of fissile materials between the sites is accomplished by the method best suited for the alternative. The RADTRAN Version 4 computer code, developed and maintained by SNL at Albuquerque, NM, was used to estimate radiological health risks (SNL 1992b). Unit risk factors were developed for each type of material to estimate the potential risk of transporting truckload shipments by SST over intersite routes. These unit risk factors were used, in conjunction with distance and the number of shipments, to estimate potential radiological and nonradiological (from air pollution and highway accidents) impacts to transport crew members and the public. Transportation impacts, in terms of total potential fatalities, were calculated using the RADTRAN computer code with the projected inventories of fissile materials and their form (nuclide composition), under each alternative considered, and based on nearest routing between sites. Fatalities from potential air pollution were estimated using 1.0×10^{-7} cancer fatalities per urban kilometer. Highway accidents fatalities were estimated from national statistics using 1.5×10^{-8} rural, 3.7×10^{-9} suburban, and 2.1×10^{-9} urban for occupational risks per km, and 5.3×10^{-8} rural, 1.3×10^{-9} suburban, and 7.5×10^{-9} urban for nonoccupational risks per km (SNL 1986a:167). Transportation impacts, in terms of total potential fatalities, were calculated using the RADTRAN computer code with the projected inventories of fissile materials and their form (nuclide composition), under each alternative considered, and based on best direct routing between sites. The transportation accident model in RADTRAN assigns accident probabilities to a set of accident categories. For the truck analysis, the eight accident-severity categories defined in NRC's *Final Environmental Impact Statement on the Transportation of Radioactive Material by Air and Other Modes* (NUREG-0170, December 1977) were used. The least severe accident category (Category I) represents low magnitude of crush force, accident-impact velocity, fire duration, or puncture-impact speed. The most severe category (Category VIII) represents a large crush force, high accident-impact velocity, long fire duration, and high puncture-impact speed, such as 88-km/hr (55-mph) collision into the side of the vehicle, and a 982 °C (1,800 °F) fire lasting 1.5 hr to produce a release of material. The release fractions for Category VIII accidents were conservatively estimated to be 0.1 for the strictly controlled SST shipments and 1.0 for other shipments.

For facilities without a specific site, a bounding risk was established in order to estimate impacts for distances of 1,000 km (621 mi), 2,000 km (1,243 mi), and 4,000 km (2,486 mi), assuming rural, suburban, and urban

population distribution of 84, 15, and 1 percent, respectively. For generic representative sites, no specific highway routes were used in the transportation modeling process; the risks for three representative distances are presented for comparison purposes. Under the European MOX fuel fabrication option, the impacts were assessed for transporting Pu materials from DOE origins (that is, from storage, pit disassembly/conversion site, or Pu conversion site) to placement of the material aboard ship. Port handling risks were estimated and ocean transport impacts (global commons) were calculated from the U.S. port to the European port, using RADTRAN. Environmental analyses of overseas port handling, land transport, and handling at the overseas plant would be the responsibility of the European fuel fabrication recipient. The impacts from ocean transport of MOX fuel back to the United States and truck transport from the port to a reactor or storage site were also calculated. The potential health impacts are presented as bounding values equal to the maximum potential risk for both accident and accident-free scenarios.

4.4.2 AFFECTED ENVIRONMENT

4.4.2.1 Transportation Procedures and Practices

Congress has mandated uniform laws for the safe transport of hazardous materials. DOT is the principal Federal agency designated by Congress to implement the regulations, ensure compliance, and provide emergency response guidance.

The Department ships hazardous materials, including radioactive materials, in full compliance with Federal laws specifically covering the transport of these hazardous materials (49 CFR 171-178). These laws are applicable to, and cannot be preempted by, individual states. Although not required by law, DOE has a policy of coordinating the transport of certain hazardous materials, such as Pu and HEU, with State officials. The actual routes are classified; however, they are selected to circumvent populated areas, maximize the use of interstate highways, and avoid bad weather. Exceptional precautions are taken to ensure safe transport. Although DOE has experienced traffic accidents related to the interstate transport of radioactive materials, there has never been a traffic accident involving the release of radioactive material causing injury or death. DOE coordinates emergency preparedness plans and responses with involved states.

The safe, secure transportation of special nuclear materials includes special vehicles and special transportation operational procedures. The design of the vehicles and the transportation operating procedures are classified; however, there has never been a failure of this system to provide safe secure transportation during more than 20 years of operation (DOE 1993ff:1-4).

Special nuclear materials, which include Pu and HEU, require extra measures to ensure physical security and protection of the public from radiation during transportation. DOE's Transportation Safeguards Division (TSD), located in Albuquerque, New Mexico, has the responsibility to provide for the transport of these materials. The TSD was established in 1975 and has accumulated over 110 million km (70 million mi) of over-the-road experience with no accidents causing a fatality or release of radioactive material. DOE's transportation vehicle, the SST, is a specially designed part of an 18-wheel tractor-trailer truck that incorporates various deterrents to prevent unauthorized removal of the cargo. It would be difficult to distinguish these trucks from most other semi-trailer trucks operating on the nation's highways. However, there are significant differences. The SST is designed to protect the cargo in the event of an accident through superior structural characteristics and a highly reliable cargo tie down system similar to that used in aircraft. The thermal characteristics of the SST would allow the trailer to be totally engulfed in a fire without incurring damage to the cargo. The tractor-trailers and their escort vehicles are equipped with communications, radiological monitoring, and other equipment, which further enhance en route safety and security.

Armed nuclear materials couriers, who are Federal officers, accompany each shipment containing special nuclear material. These couriers are hand-picked and highly trained in tractor-trailer driving and electronic and communication systems operation, and are authorized by AEA to carry firearms and make arrests in the

performance of their duties. They drive the tractor-trailers and escort vehicles and operate the communications and other convoy equipment. The couriers must meet periodic qualification requirements for firearms, physical fitness, and driving proficiency. They also must pass an annual medical examination and are subject to random drug and alcohol testing.

The Department makes every effort to ensure that its convoys travel at safe speeds and do not travel during inclement weather. Should the convoys encounter adverse weather, provisions exist for them to seek secure shelter at previously identified facilities. A liaison program provides State and local law enforcement officers information on what actions to take to assist one of these vehicles should it be involved in an accident. A DOE control center maintains an emergency contact directory of Federal, State, and local response organizations located throughout the contiguous United States. [Text deleted.]

As further described in Appendix G, the vehicles and transport procedures are specifically designed and tested to prevent a radiological release under all credible accident scenarios. In addition, the packaging is designed and tested to prevent releases. DOE requires the use of highly sophisticated Type B packaging, which is designed to prevent the release of contents under all credible transportation accident conditions, for shipments of Pu and HEU. The testing requirements for these packagings are very demanding. For example, the drop test is equivalent to an impact on a hard surface at 322 km/hr (200 mph) without serious damage to the package or release of its radioactive contents. The containers used for shipping Pu and HEU must pass extremely rigid drop, puncture, thermal, and water immersion testing, and secure approval certification by DOT, NRC, and DOE.

4.4.2.2 Site Transportation Interfaces for Hazardous Materials

The existing transportation modes that serve each DOE site under consideration and the links to those modes for the intersite transport of hazardous materials are summarized in Table 4.4.2.2-1. Although hazardous materials could be transported by rail, truck, air, and barge modes, the materials (including hazardous materials) associated with storage and disposition would be transported only by truck and rail. Pu, including MOX fuel, and HEU would be transported exclusively by SST. Immobilized materials, blendstock for MOX fuel fabrication, TRU waste, and LLW would be transported by certified commercial truck carriers. Pu materials immobilized with highly radioactive isotopes would be transported by rail to a repository. Radioactive CsCl capsules would be shipped by commercial carriers or SST depending on the quantity, in accordance with DOE Order 5633.36. For this analysis, shipment by commercial carrier was assumed. There would be no barge or air shipments and, therefore, there would not be any impacts from transportation by these modes.

Table 4.4.2.2-1. Transportation Modes and Comparison Ratings by Site

Site	Onsite Railroad Service	Nearest Interstate Highway (km)	Distance to Airport for Cargo Shipments (km)	Barge Service	Possible Weather Delays ^a	Overall Level of Transport Service
Hanford	Yes	32	15	Yes	Yes	Good
NTS	No	97	105	No	No	Good
INEL	Yes	74	40	No	Yes	Good
Pantex	Yes	23	11	No	Minimal	Outstanding
ORR	Yes	6	61	Yes	Minimal	Good
SRS	Yes	48	32	Yes	Minimal	Good
RFETS	Yes	16	40	No	Yes	Satisfactory
[Text deleted.]						
LANL	No	66	177	No	Yes	Satisfactory

^a DOE Transportation Safeguards System shipments.

Source: DOE 1991j; LANL 1992a:1; NTS 1992a:3; RFP 1992b:2.

In the *Nuclear Weapons Complex Reconfiguration Site Evaluation Panel Report*, five sites (Hanford, INEL, ORR, Pantex, and SRS) have been given a comparative rating based on the strengths and weaknesses of their transportation services (DOE 1991j:7). For consistency, the rating methodology and evaluation procedures established by the Nuclear Weapons Complex Reconfiguration Site Evaluation Panel were applied to the remaining DOE sites under consideration. Although DOE has experienced traffic accidents related to the intersite transport of radioactive materials, there has never been a traffic accident involving a release of radioactive material causing injury or death during transportation.

The Department's hazardous material (radioactive and nonradioactive) shipments are small compared to the large shipment volume from non-DOE hazardous material transported within the United States. DOT estimates that approximately 3.6 billion t/yr (4.0 billion tons/yr) of regulated hazardous materials are transported and that approximately 500,000 movements of hazardous materials occur each day (PL 101-615, Section 2[1]). There are approximately 2 million annual shipments of radioactive materials involving about 2.8 million packages, which represents about 2 percent of the annual hazardous materials shipments. Most radioactive shipments involve small or moderate quantities of material in relatively small packages. In comparison, the DOE Nuclear Weapons Complex ships about 6,200 radioactive packages (commercial and classified) annually among its sites. DOE's annual shipments of radioactive packages have represented less than 0.3 percent of all radioactive shipments in the United States. Up to a maximum of 603 shipments per year of radioactive material would be generated for any alternative in this PEIS. This is about 0.03 percent as compared to the total of 2 million shipments, although the size of each shipment may be larger than commercial shipments. Information on each site's historical transportation shipment records is included in Appendix G.

[Text deleted.]

4.4.2.3 Packaging

All Pu, HEU, and MOX fuel to be relocated under this PEIS would be packaged in DOT-approved Type B containers and transported by SST. Packaging refers to a container and all accompanying components or materials necessary to perform its containment function. Packagings used by the DOE for hazardous materials shipments are either certified to meet specific performance requirements or built to specifications described in the DOT hazardous materials regulations (49 CFR 171-180). For relatively low-level radioactive materials, strong, tight packagings or DOT specification Type A packagings are used. These packagings are designed to retain their contents under normal transportation conditions. Shipments of more sensitive radioactive materials require use of highly sophisticated Type B packaging, designed and tested to prevent the release of contents under all credible transportation accident conditions. Each Type B packaging must pass four extremely rigid regulatory tests (drop, puncture, thermal, and immersion) that cover essentially 100 percent of the probable and hypothetical accidents involving impact, puncture, fire, and water immersion. It is highly unlikely that all four accident scenarios would occur to the same package, thus the regulatory requirements are conservative.

Special nuclear material (Pu and HEU) and certain other radioactive materials or weapons components require special protection. In addition to meeting the stringent Type B containment and confinement requirements of NRC's 10 CFR 71 and DOT's 49 CFR, packaging for nuclear weapons and components must be certified separately by DOE. The DOE operates the Transportation Safeguards System for the intersite transport of weapons and components, including Pu and HEU. Specially designed SST are utilized to ensure high levels of safety and physical protection. The system for safe secure transport of Pu and HEU is described in Appendix G.

Typical packagings for the materials analyzed in this PEIS are the DOT specification 6M, Type B or equivalent packaging for the shipment of Pu and HEU; the AT-400A or FL, Type B packaging for Pu pits; the Westinghouse model MO-1, Type B packaging for new MOX fuel; the BUSS R-1 cask for CsCl capsules; the TRUPACT for TRU waste; and Type B truck and rail casks for immobilized materials and MOX spent nuclear fuel. Most other radioactive materials would be transported by commercial truck in Type A fissile packagings. As a representation, a typical testing sequence for the 6M, Type B packaging used for the shipment of Pu and HEU

is described in Appendix G. Table 4.4.2.3–1 presents a summary of the radioactive materials, packagings, and affected sites analyzed in this PEIS. [Text deleted.]

4.4.2.4 Transportation Routes and Emergency Preparedness Coordination Among Federal, State, and Local Agencies

Federal laws govern the transport of hazardous materials in the United States to ensure the safety of the public and security of the cargo. The DOT is the principal Federal agency designated by Congress to implement the regulations, ensure compliance, and provide emergency response guidance. Transportation of Pu and HEU, MOX fuel, and immobilized Pu radioactive materials covered by this PEIS would be transported through numerous States in full compliance with Federal laws (49 CFR) that are applicable to individual States. The actual routes would be classified; however, they are selected with input from State and local agencies to circumvent populated areas, maximize the use of interstate highways, and avoid adverse weather. The actual routes would not be designated until the time of transport. Exceptional precautions are taken to ensure safe transport. In addition, DOE has a liaison program through which it communicates with law enforcement and public safety agencies throughout the country, making them aware of these shipments and the exceptional precautions being taken to ensure safe transport through their state.

The packaging, vehicles, and transport procedures are specifically designed and tested to prevent a radiological release under all credible accident scenarios. However, if an emergency situation were to occur, Federal, State, and local emergency preparedness officials are trained and prepared to react to such an emergency. The FEMA is responsible for establishing policies for, and coordinating civil emergency management, planning, and interaction with Federal executive agencies that have emergency response functions in the event of a transportation incident. The FEMA coordinates Federal and State participation in developing emergency response plans and is responsible for the development of the interim *Federal Radiological Emergency Response Plan*. This plan is designed to coordinate Federal support to State and local governments, upon request, during the event of a radiological material transportation incident. FEMA also routinely identifies entities at the State and local levels with whom DOE officials should coordinate to ensure emergency preparedness for specific DOE transportation of Pu or HEU. DOE also has access to transportation coordinators in the Local Emergency Planning Councils and Area Planning Contingency Groups which are required to be formed at the regional and local levels under the *Emergency Planning and Community Right-To-Know Act* of 1986. DOE assists in the training of local emergency preparedness officials in how to respond to such emergencies and how to use certain monitoring equipment. FEMA, which runs the National Fire Academy, also conducts civil defense training of local firefighters. Since firefighters are often the first responders to any type of emergency, the FEMA training includes emergency response to radiological incidents.

4.4.3 ENVIRONMENTAL CONSEQUENCES

Weapons-usable fissile materials analyzed in this PEIS would be either dispositioned or placed into long-term storage. [Text deleted.] This section summarizes the health impacts from the intersite transportation of Pu, HEU, MOX fuel, Cs-137, and other radioactive materials, including waste, based on RADTRAN model results. Impacts are presented based on the movements of the total amount of materials considered under each storage and disposition alternative for the life of the project.

Normal operations associated with the storage and disposition of weapons-usable fissile materials could result in the exposure of transportation workers and the general public to toxic chemicals from vehicular emissions and radiation from the transport of radiological feed materials, products, and wastes generated to accomplish various storage and disposition alternatives. During normal operations (that is accident-free transportation), of radioactive and nonradioactive materials (that is, Pu, HEU, CsCl capsules, canisters of immobilized Pu with radionuclides, MOX fuel, spent nuclear fuel, and wastes), the general population living and traveling along the transport route has a risk of exposure to radioactive and non-radioactive materials (that is, a small amount of

Table 4.4.2.3-1. Transportation Summary of Radioactive Materials and Packagings for Alternatives

	Long-Term Storage				Disposition—Common Activities									
	Upgrade ^a Consolidation		Collocation		Pit Disassembly/Conversion					Pu Conversion				
	Input	Pu	Input 1	Pu	Input 2	HEU	Pu	Input	Pu	Output 1	TRU waste	Output 2	LLW	Output 3
Materials	Pu													
Form	Pits, metal, oxide	Pits, metal, oxide	Pits, metal, oxide	Pits, metal, oxide	Canned sub-assemblies, metal or oxide		Pits	Metal or oxide		Metal or oxide	Metal or oxide	Solid	TRU waste	LLW
Quantity per year (kg)	27,000	27,000	27,000	27,000	15,080		2,000	2,000	15,000	12,000	1,000	661	35,890	308,162
Quantity per package (kg)	4.5	4.5	4.5	4.5	5.2		45	45	980	2,200	4.5	4.5	980	2,200
Packages per shipment	35	35	35	35	35		35	35	3	5	35	35	3	5
Shipments per year	172	172	172	172	83		13	13	6	2	7	5	13	28
Packages (type)	AT-400A (B), FL (B) and 6M (B)	AT-400A (B), FL (B) and 6M (B)	AT-400A (B), FL (B) and 6M (B)	AT-400A (B), FL (B) and 6M (B)	6M (B)		AT-400A (B) and FL (B)	6M (B)	TRUPACT (B)	Metal box (A)	6M (B)	6M (B)	TRUPACT (B)	Metal box (A)
Potential origins	Hanford INEL RFETS LANL	Hanford INEL RFETS LANL	Hanford INEL RFETS LANL	Hanford INEL RFETS LANL	Y-12 Plant		Pantex SRS RFETS	Hanford NTS INEL Pantex ORR SRS	Hanford NTS INEL Pantex ORR SRS	Hanford NTS INEL Pantex ORR SRS	Hanford INEL Pantex SRS RFETS LANL	Hanford NTS INEL Pantex ORR SRS	Hanford NTS INEL Pantex ORR SRS	Hanford NTS INEL Pantex ORR SRS
Potential destinations	Hanford INEL Pantex SRS	Hanford NTS INEL Pantex ORR SRS	Hanford NTS INEL Pantex ORR SRS	Hanford NTS INEL Pantex ORR SRS	Hanford NTS INEL Pantex ORR SRS		Hanford NTS INEL Pantex ORR SRS	Lag storage or disposition ^c	WIPP or alternative	LLW disposal site	Hanford NTS INEL Pantex ORR SRS	Lag storage or disposition ^c	WIPP or alternative	LLW disposal site
Mode	SST	SST	SST	SST	SST		SST	SST	Truck	Truck	SST	SST	Truck	Truck

Table 4.4.2.3-1. Transportation Summary of Radioactive Materials and Packagings for Alternatives—Continued

	Immobilization									
	Vitrification				Ceramic Immobilization				Electrometallurgical Treatment	
	Input 1	Input 2	Output	Input 1	Input 2	Output	Input 1	Input 2	Output	Output
Materials	Pu	Cs	Pu/Cs glass ^d	Pu	Cs	Pu/Cs/Gd/ ceramic ^d	Pu	Cs	Pu/Cs/ TRU/ ceramic	
Form	Metal, oxide, borosilicate glass	Salt	Glass	Metal or oxide	Salt	Disks	Metal or oxide	Salt	Glass-bonded zeolite	
Quantity per year (kg)	5,000	64	100,800	5,000	64	42,000	5,000	47	104,000	
Quantity per package ^b (kg)	4.5	5.72	1,680 (84 kg Pu)	4.5	5.72	656	4.5	4.71	5,200 (260 kg Pu)	
Packages per shipment	35	1	1	35	1	1	35	1	1	
Shipments per year	32	12	60	32	12	64	32	10	20	
Packages (type)	6M (B)	BUSS cask (B)	Cask (B)	6M 1141 drum (B)	BUSS cask (B)	Cask (B)	6M 1141 drum (B)	BUSS cask (B)	Cask (B)	
Potential origins	Current or lag storage site ^c	Hanford	New glass vitrification site	Current or lag storage site ^c	Hanford	Immobilization site	Current or lag storage site ^c	Hanford	INEL	
Potential destinations	Immobilization site	Immobilization site	HLW repository	Immobilization site	Immobilization site	HLW repository	INEL	INEL	HLW repository	
Mode	SST	Truck or SST	Rail	SST	Truck or SST	Rail	SST	Truck or SST	Rail	

Table 4.4.2.3-1. Transportation Summary of Radioactive Materials and Packagings for Alternatives—Continued

	MOX Fuel Fabrication for Reactors						Deep Borehole			
	Input 1			Input 2			Direct Disposition		Immobilized Disposition	
	Pu	Oxide powder	3,000	Uranium	Oxide powder	129,600	MOX fuel	382	Pu	Pu
Materials										
Form										
Quantity per year (kg)										
Quantity per package ^b (kg)										
Packages per shipment										
Shipments per year										
Packages (type)										
Potential origins										
Potential destinations										
Mode										

^a All HEU for this project is assumed to be located at the Y-12 Plant.

^b Bounding values used for analysis purposes only.

^c Lag storage is temporary storage at a disposition facility.

[Text deleted.]

^d HLW could be combined with the immobilized Pu for the Vitrification or Ceramic Immobilization Alternatives.

Source: DOE 1996e; DOE 1996f; LANL 1996b; LLNL 1996a; LLNL 1996b; LLNL 1996c; LLNL 1996d; LLNL 1996e; LLNL 1996f; NT DOE 1996a; PX DOE 1996a.

additional vehicular emissions) from the passing shipments. Transportation workers could be similarly exposed to radioactive and non-radioactive materials. These are examples of causes of potential radiological and nonradiological fatalities resulting from normal transportation operations. Traffic accidents could have impacts to drivers, passengers, or pedestrians similar to any local or interstate traffic accident. In addition, there could be damage resulting in the releases from the hazardous cargo being transported. Appendix G describes the tests that the packages must withstand to be certified for transporting special nuclear materials. However, traffic accidents could theoretically cause radiological fatalities if there were a release of radioactive material as a result of the traffic accident, and nonradiological fatalities from the effects of vehicular crashes. Radiological and nonradiological fatalities resulting from traffic accidents could affect both the general population and the transportation workers.

Since the establishment of TSD in 1975, DOE has accumulated over 70 million miles of over-the-road experience transporting DOE owned cargo with no accidents causing a fatality or release of radioactive material. However, since there is a theoretical chance of fatalities, this PEIS modeled the potential fatalities from radiological effects of transportation (both normal operations and accident situation) and nonradiological effects of transportation (both normal operations and accident situation) for the various storage and disposition alternatives. [Text deleted.] The potential transportation risks, although small, are greatest for nonradiological traffic accidents compared to radiological risks for both normal operations and accident situations. Impacts are based on the total amount and types of materials moved, numbers of shipments, and the distances those shipments would travel.

The following sections present for each alternative the potential radiological and nonradiological fatalities to the general population and transportation workers. Transportation workers include both the driving crews and any transportation workers who load and unload the materials. Only total potential fatalities, which include radiological and nonradiological impacts for routine and accident conditions, are discussed in this section. The majority of the total impact is due to nonradiological accidents (traffic accidents), followed by radiological routine exposure, nonradiological routine exposure (air pollution), and radiological accidents. Radiological accidents typically have about 1 percent of the total fatalities.

4.4.3.1 No Action

Existing facilities would be used for continued which is the baseline case to which the transportation impacts for other alternatives is compared. Under No Action, there would be no transportation of materials as part of the proposed long-term storage and disposition alternatives, thus no transportation risks incurred.

As part of ongoing operations at the DOE sites, fissile materials may require movement and offsite transportation. These actions, however, would be addressed in separate site-specific environmental documentation, as appropriate.

[Text deleted.]

4.4.3.2 Long-Term Storage Alternatives

Upgrade Alternative

Preferred Alternative for Storage

For the Preferred Alternative for storage, all Pu would be shipped from RFETS. The Pu pit material would be shipped from RFETS to Pantex; the non-pit Pu material would be shipped from RFETS to SRS. Shipments from RFETS would begin in 1997. Pits at SRS are strategic reserve and would be stored according to the ROD for the Stockpile Stewardship and Management PEIS. For analysis of intersite transportation impacts of the Preferred Alternative, the only contributors to intersite transportation risks would be the requirement to ship Pu

pits from RFETS to Pantex and to ship non-pit Pu from RFETS to SRS. Intrasite transportation between Zone 4 and Zone 12 at Pantex would occur for the Preferred Alternative if pits are stored in Zone 4 before the upgrade facility is available. Analysis of this intrasite transportation is discussed in Appendix Q. HEU and non-RFETS Pu would remain at existing locations so there would be no additional contributors to transportation risks. All HEU is assumed at ORR. All nonsurplus HEU and surplus HEU pending disposition would be stored in upgraded facilities at ORR under the Preferred Alternative. Pu material currently at Hanford, INEL, Pantex, SRS, and LANL would remain onsite pending disposition (or lag storage at the disposition facilities). The impacts in terms of potential fatalities are based on risks from normal (accident-free) operations and from accidents, both radiological and nonradiological operations and accidents. The risks are based on quantities and types of Pu material as well as the distance, routes, and number of SST trips required. Potential fatalities from intersite transportation activities for the Preferred Alternative are summarized in Table 4.4.3.2-1. Nonradiological accidents are the dominant risk for the Preferred Alternative.

Table 4.4.3.2-1. Total Potential Fatalities From Intersite Transportation Activities for the Preferred Alternative for Storage^a

Material	Ship From	Ship To	Total Potential Fatalities
Pu Pits	RFETS	Pantex	0.00636
Non-Pit Pu	RFETS	SRS	0.0602
Total Transportation Risk			0.0666

^a Resulting from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions.

Source: RADTRAN model results.

Upgrade Without Rocky Flats Environmental Technology Site Plutonium or Los Alamos National Laboratory Plutonium Subalternative

Under this subalternative, four sites are considered for the upgrade of existing Pu storage facilities: Hanford, INEL, Pantex, and SRS. Pu material from RFETS and LANL included in this PEIS would remain at these two sites. HEU would continue to be stored at ORR. For this subalternative there would be no potential fatalities because intersite transportation would not occur.

Upgrade With Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium Subalternative

Under this subalternative, four sites are considered for the upgrade of existing Pu storage facilities: Hanford, INEL, Pantex, and SRS. Pu material from RFETS and LANL included in this PEIS would be transported to one or more of these four sites. HEU would continue to be stored at ORR. The estimated potential impact from transporting the Pu materials from RFETS and LANL to each potential storage site is presented in Table 4.4.3.2-2. In the case where the RFETS and LANL Pu material would be distributed to more than one site for storage, the resulting number of total potential fatalities would be within the range of values, 0.031 to 0.087, shown in Table 4.4.3.2-2, and fatalities per site would be less than the maximum values shown. [Text deleted.] Nonradiological accidents are the dominant risk for the Upgrade With RFETS Pu and LANL Pu Subalternative.

Consolidation Alternative

Under this alternative, weapons-usable Pu would be transported from existing storage sites to one of five potential consolidated storage facilities located at Hanford, NTS, INEL, Pantex, or SRS (ORR is excluded as a Pu-only storage site). The total potential number of fatalities resulting from transporting Pu to each site under the

Table 4.4.3.2–2. Total Potential Fatalities From the Transportation of Rocky Flats Environmental Technology Site Plutonium and Los Alamos National Laboratory Plutonium for the Upgrade Alternative^a

Candidate Sites ^b	Total Potential Fatalities ^c
Hanford	0.051
INEL	0.032
Pantex	0.031
SRS	0.087

^a Resulting from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions.

^b Under the Upgrade Alternative, NTS and ORR are not potential storage sites for Pu, and HEU would remain at ORR.

^c Effect of transporting all Pu from RFETS and LANL covered by this PEIS to one site.

Source: RADTRAN model results.

Consolidation Alternative is shown in Table 4.4.3.2–3. The highest number of potential fatalities, however, would not exceed 0.346, which is based on moving all Pu covered by this PEIS from existing sites to SRS. Nonradiological accidents are the dominant risk for the Consolidation Alternative.

Table 4.4.3.2–3. Total Potential Fatalities From the Transportation of Plutonium for the Consolidation Alternative^a

Candidate Sites ^b	Potential Fatalities
Hanford	0.272
NTS	0.172
INEL	0.203
Pantex	0.079
SRS	0.346

^a Resulting from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions.

^b Under this alternative, ORR is not a potential Pu storage site.

Source: RADTRAN model results.

Collocation Alternative

Under this alternative, weapons-usable Pu and HEU would be transported from existing storage sites to one of six potential collocation storage sites at Hanford, NTS, INEL, Pantex, ORR, or SRS. The transportation health effects were calculated individually for each fissile material going to each of the candidate sites, and then summed. The highest number of potential fatalities, however, would not exceed 1.070, which is based on moving all material to Hanford. The total potential number of fatalities resulting from transporting Pu and HEU under the Collocation Alternative are summarized in Table 4.4.3.2–4. Nonradiological accidents are the dominant risk for the Collocation Alternative.

For both the Consolidation and Collocation Alternatives, all the weapons-usable Pu stored at RFETS and surplus Pu materials currently stored at LANL are included in the analyses for intersite transportation. [Text deleted.]

Table 4.4.3.2—4. Total Potential Fatalities From the Transportation of Plutonium and Highly Enriched Uranium for the Collocation Alternative^a

Candidate Sites	Potential Fatalities
Hanford	1.070
NTS	0.829
INEL	0.873
Pantex	0.458
ORR	0.285
SRS	0.495

^a Resulting from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions.

Source: RADTRAN model results.

Phaseout

If a site is selected for phaseout, the total potential fatalities impacts of relocating excess Pu or HEU to other DOE sites would be similar to the impacts calculated under the storage and disposition alternatives. [Text deleted.]

Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

For each of the long-term storage alternatives where the strategic reserve and weapons R&D is not included as part of this program, the transportation health risks associated with the remaining fissile materials has been proportionally estimated from the risks calculated for the entire inventory. Since less material would be moved, the overall result would be potentially fewer fatalities for each alternative. Most of the material is surplus and therefore the reduction would be less than one half of the total fatalities with the strategic reserve.

4.4.3.3 Disposition Alternatives

Alternatives for disposition are intended to permanently prevent certain surplus Pu materials from being used to produce nuclear weapons. The alternative categories are Deep Borehole, Immobilization, and Reactor. Under these disposition alternatives, it is assumed that the surplus fissile materials have been placed in storable forms, suitable for shipment, at the facility of origin.

For the disposition alternatives, the following would apply:

- Almost all surplus Pu pits are located at Pantex, with a limited quantity at RFETS. Pu pits would be transported from existing storage, primarily at Pantex, to potential pit disassembly/conversion sites (unless pit disassembly/conversion is located at the existing storage site). For transportation analysis purposes, pit disassembly/conversion is assumed to be located at one of the following sites: Hanford, NTS, INEL, Pantex, ORR, or SRS, and all pits would be transported from Pantex.
- Non-pit Pu material would be transported from existing storage to a Pu conversion site. For transportation risk analysis purposes, it is assumed that the Pu conversion function would be located at one of six sites: Hanford, NTS, INEL, Pantex, ORR, or SRS. The material would be in a form suitable for shipment in compliance with DOT regulations (49 CFR).
- Surplus Pu at RFETS and at LANL is also being considered for disposition, therefore, is included in the intersite transportation analysis. RFETS and LANL are not being considered for any disposition functions, such as pit disassembly/conversion or immobilization of materials.

- For the disposition actions, the transport of surplus Pu would always originate at either the existing storage sites (Hanford, INEL, Pantex, SRS, RFETS, and LANL) or at the potential pit disassembly/conversion or Pu conversion site (Hanford, NTS, INEL, Pantex, ORR, or SRS).

Table 4.4.3.3–1 presents the total potential health impact from the transportation of Pu from existing storage sites to pit disassembly/conversion or Pu conversion sites. Included in the impact is the effect from the transport of LLW and TRU waste generated. Nonradiological accidents are the dominant risk for both the pit disassembly/conversion and Pu conversion alternatives.

Table 4.4.3.3–1. Total Potential Fatalities From the Transportation of Plutonium From Existing Storage Sites to a Pit Disassembly/Conversion or Plutonium Conversion Site^a

Sites Analyzed	Pit Disassembly/Conversion	Pu Conversion
Hanford	0.203	0.455
NTS	0.107	0.211
INEL	0.155	0.340
Pantex	0.033	0.293
ORR	0.155	0.557
SRS	0.190	0.635

^a Includes effect from the transport of Pu, LLW, and TRU waste from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions.

Source: RADTRAN model results.

[Text deleted.]

The total potential fatalities presented in Table 4.4.3.3–1 are based on transporting 30 t (33.1 tons) of pits to the pit disassembly/conversion site and 20 t (22 tons) of Pu to the Pu conversion site. Should the amount of material be less than these amounts, the risk would be lower than these values.

Deep Borehole

Under the deep borehole category, surplus weapons-usable Pu would be in one of two forms: (1) containers of stabilized Pu would be directly emplaced in a borehole and (2) Pu-loaded, ceramic-coated pellets would be emplaced in a borehole. This category of alternatives requires surplus Pu to be transported from lag storage to the borehole site, or to an immobilization site and then to the borehole site. A specific borehole site has not been selected; therefore, for transportation analysis purposes, generic distances of 1,000, 2,000, and 4,000 km (621, 1,243, and 2,486 mi) were used. The amount of Pu to be transported is estimated to not exceed 5 t (5.5 tons) per year.

Under the Direct Disposition Alternative, Pu material would be packaged in 2.25-kg (5-lb) lots (in metal or oxide form) in metal cans at the pit disassembly/conversion site or Pu conversion site. Two cans of Pu (4.5 kg [10 lb]) would be placed into each DOT-specification 2R inner container, which, in turn, would be placed in DOT specification 6M, Type B packaging and shipped by SST to the borehole site. Each shipment (truckload) would contain 35 packages. There would be a total of 32 shipments per year. The shipping containers would be placed directly into metal emplacement canisters at the borehole site without additional handling of Pu material.

Under the Immobilized Disposition Alternative, Pu material would be packaged in 2.25-kg (5-lb) lots (in metal or oxide form) in metal cans, as described above. Two cans would be placed into each DOT-specification 6M, Type B packaging and shipped to a ceramic immobilization facility. There, the material would be converted into Pu-loaded,

ceramic-coated pellets (1-percent Pu). The Pu-loaded, ceramic-coated pellets would be shipped in Type B, 208-l (55-gal) drum packaging by SST or commercial truck to the deep borehole site. An estimated 500 t (551 tons) of Pu-loaded, ceramic-coated pellets would be transported per year. This would consist of transporting 510 kg (1,124 lb) of material per Type B package, five packages per SST or commercial truckload shipment, and 981 packages or 197 shipments per year.

The total potential number of fatalities resulting from the transportation of Pu for each of the deep borehole alternatives are shown in Table 4.4.3.3–2. These risks include: (1) the transport of material directly to a deep borehole site, and (2) the transport of material to an immobilization site and then the transport of ceramic pellets from the immobilization site to a deep borehole site. The impacts in Table 4.4.3.3–2 also include the maximum health effect from transporting Pu from existing storage to a pit disassembly/conversion site or Pu conversion site, as derived from Table 4.4.3.3–1. Nonradiological accidents are the dominant risk for the Deep Borehole Category of Alternatives. To calculate the maximum impacts in Table 4.4.3.3–2, 5 t (5.5 tons) of Pu would be transported annually from the farthest lag storage site.

Table 4.4.3.3–2. Total Potential Fatalities From the Transportation of Plutonium and Immobilized Materials for the Deep Borehole Category of Alternatives^a

Alternative	Sites Analyzed	Total Potential Fatalities ^b
Direct Disposition	No immobilization	1.18
Immobilized Disposition	Hanford	1.95
	NTS	1.62
	INEL	1.79
	Pantex	1.62
	ORR	2.01
	SRS	2.12

^a Resulting from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions.

^b Based on a distance of 4,000 km to a deep borehole site.

Source: RADTRAN model results.

Immobilization

Under the immobilization category, surplus Pu (in metal or oxide form) would be transported to one of six sites analyzed (Hanford, NTS, INEL, Pantex, ORR, or SRS). Regardless of the site or immobilization technology selected, the amount of Pu to be transported is estimated to not exceed 5 t (5.5 tons) per year.

It is estimated that for 5 t (5.5 tons) of Pu, 35 6M Type B packages would be shipped in each of 32 SST truckloads per year (a total of 1,111 6M packages per year). If the surplus Pu is immobilized with Cs-137, approximately 64 kg (141 lb) of CsCl capsules per year, in approximately 12 BUSS R-1 casks, would require shipment from Hanford to the immobilization site.

The immobilized Pu would be transported in NRC-certified packagings to the HLW repository program in one of two alternative forms; these are:¹

- **Plutonium, Cesium, and Gadolinium in Vitrified Glass Logs.** Under the Vitrification Alternative, an estimated 101 t (111 tons) of material would be transported per year. This would consist of transporting approximately 1,680 kg (3,704 lb) of material (including 84 kg [185 lb] of Pu and

¹ A variant for both vitrification and ceramic immobilization is to use HLW in place of Cs-137. Use of this material for either alternative would have less total fatalities since HLW would be resident at the site already.

2.1 kg [4.6 lb] of Cs-137) per rail cask, 1 cask per rail shipment, and 60 casks or 60 shipments per year.

- **Plutonium, Cesium, and Gadolinium in Ceramic Disks.** Under the Ceramic Immobilization Alternative, an estimated 42 t (46 tons) of material would be transported per year. This would consist of transporting 656 kg (1,446 lb) of material per rail cask, one cask per rail shipment, and 64 casks or 64 shipments per year.

The total potential fatalities for the transportation of Cs-137 from Hanford to each of the immobilization sites analyzed would range from 0.024 to 0.086. If HLW is used for either the Vitrification or Ceramic Immobilization Alternative there would be 0 total potential fatalities because only HLW onsite where the facility is located would be used. For calculating transportation risks, the representative HLW repository site is assumed at Yucca Mountain, Nevada, for reasons described in Appendix H.

A summary of the maximum health effects from transportation of radiological materials under the immobilization alternative category is presented in Table 4.4.3.3–3. Impacts include the maximum health effects from transporting Pu from existing storage to a pit disassembly/conversion site or Pu conversion site. To calculate the impacts, 5 t (5.5 tons) of Pu would be transported annually from the lag storage² site farthest from each of the immobilization sites. Nonradiological accidents are the dominant risk for the Immobilization Category of Alternatives. Under the Preferred Alternative, for analysis purposes, 30 percent of the surplus Pu would be sent to the Pu conversion facility and then either to the vitrification or ceramic immobilization facility. Accordingly, the total potential fatalities for the Preferred Alternative would be lower than those shown in Table 4.4.3.3–3.

Table 4.4.3.3–3. Total Potential Fatalities From the Transportation of Plutonium and Immobilized Materials for the Immobilization Category of Alternatives^a

Alternative	Sites Analyzed					
	Hanford	NTS	INEL	Pantex	ORR	SRS
Vitrification	0.96	0.49	0.75	0.70	1.25	1.40
Ceramic Immobilization	0.98	0.50	0.77	0.72	1.28	1.43

^a The analysis assumed that the pit disassembly/conversion and Pu conversion would be collocated at the immobilization site. The analysis includes effect of transporting Cs-137 from Hanford to the immobilization site and the transportation of immobilized materials to a HLW repository site, resulting from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions.

Note: Under the Preferred Alternative, for analysis purposes, 30 percent of the surplus Pu would be sent to the Pu conversion facility and then either to the vitrification or ceramic immobilization facility. Accordingly, the total potential fatalities for the Preferred Alternative would be lower than those shown in this table.

Source: RADTRAN model results.

Another immobilization alternative analyzed is electrometallurgical treatment. ANL-W has been analyzed as the representative site, although electrometallurgical treatment could be performed at any site and would give different transportation impacts. Under this alternative, using ANL-W as the representative site, all surplus Pu (in metal or oxide form) would be transported from SRS (the bounding site) to ANL-W located at INEL where it would be immobilized with spent nuclear fuel and Cs-137 at an electrometallurgical treatment facility to produce glass-bonded zeolite, vitrified in canisters as waste. Canisters of GBZ would then be shipped to a HLW repository program. The annual amount of Pu feed material for this process would be identical to that required for the other immobilization processes described above. Approximately 5 t (5.5 tons) of Pu (1,111 packages, 35 packages per SST, 32 SST loads) would be required per year. Pu would be shipped to INEL in DOT-approved 6M, Type B packaging (using 2R inner containers) with approximately 4.5 kg (10 lb) of Pu per package. For the

² Lag storage is temporary storage at a disposition facility.