transport of Cs-137 feed material from Hanford, approximately 64 kg/yr (141 lb/yr) of Cs-137, consisting of one rail cask per shipment, 10 shipments per year, would be required. To transport an estimated 104,000 kg/yr (229,278 lb/yr) of GBZ to a repository by rail would require approximately 20 shipments per year, each shipment consisting of one cask (20 casks/yr), or approximately 200 shipments (200 casks) over the 10-year life of the project. This assumes a repository is available and the shipments are made during the 10-year glass bonding production period; otherwise, the immobilized material would be stored onsite until the HLW program accepts the material. The total potential fatalities resulting from the transport of radioactive materials under this alternative is 0.923.

Mixed Oxide Fuel for Reactors

Surplus Pu (oxide powder) would be transported from the lag storage sites (after pit disassembly/conversion or Pu conversion) to domestic or foreign MOX fuel fabrication plants for blending into MOX nuclear reactor fuel. It is estimated that the maximum amount of Pu oxide to be transported per year from lag storage to a MOX fuel fabrication plant would not exceed 3 t (3.3 tons). For domestic MOX fuel fabrication, approximately 20 SST truckloads, consisting of 35 DOT-specification 6M, 113.6-l (30-gal) packages per SST, would be expected to move to the MOX fuel fabrication site each year. It is estimated that the maximum amount of UO_2 powder to be transported per year would be 130 t (143 tons). Approximately 12 truckloads, consisting of five DOT-specification Type A metal boxes per truckload, would also be transported to the MOX fuel fabrication site each year. Each metal box would contain about 2,200 kg (4,850 lb) of UO_2 material.

After processing the Pu at a domestic MOX fuel fabrication plant, a maximum of 133 t (147 tons) of MOX fuel (PuO_2 and UO_2), in reactor fuel bundles, would be transported in approximately 174 truckloads per year to a commercial reactor site or an approved DOE interim storage site. Each truckload contains approximately 2 packages. The Westinghouse Electric model MO-1 shipping cask (NRC Certificate 9069) is used for this analysis. Each cask would contain approximately 23 kg (51 lb) of PuO_2 and 359 kg (791 lb) of UO_2 with an average of 6-percent Pu. Based on an estimated 3,272 t (3,607 tons) of MOX fuel for the entire MOX fuel project, an estimated total of 4,283 truckloads would be required.

The final destination for the MOX fuel could be any reactor capable of using this fuel. After processing the oxides of Pu and uranium into MOX fuel, the fuel has not met the Spent Fuel Standard. However, Pu in the form of MOX fuel is less weapons-usable and much less susceptible to dispersion into the environment than Pu in the oxidized form prior to MOX fuel fabrication. MOX fuel is less weapons-usable because it would require some chemical processing to reclaim the Pu metal. Still, security measures must be implemented and similar measures are routinely in place in the U.S. domestic nuclear power industry for manufacturing and transporting uranium-based fuel to reactor sites. DOE would ensure that MOX fuel is protected by comparable security measures for point of fabrication through usage in a reactor. MOX fuel is less susceptible to dispersion in the environment because the Pu is contained in a pellet and the pellets are contained in a fuel rod. The structural integrity of the fuel rods make dispersion of even the pellets, much less the Pu inside the pellets, very unlikely. Because MOX fuel is less weapons-usable and less dispersable, after fabrication the MOX fuel would be transported by SST with appropriate security protection as described in Appendix G. To allow for comparison of the reactor alternatives, an estimated risk to transport MOX fuel from a MOX fabrication site to a reactor site within the United States or to the Canadian Border (hypothetical distance of 1,000, 2,000, or 4,000 km [621, 1,243, or 2,486 mi]) was used.

The total health risk impacts from transporting both Pu by SST and uranium oxide by truck to potential MOX fuel fabrication plants (hypothetically located 1,000, 2,000, or 4,000 km [621, 1,243, or 2,486 mi] from origin) and to an ocean terminal (hypothetically located at Sunny Point, NC, approximately 1,000, 2,000, or 4,000 km [621, 1,243, or 2,485 mi] from origin), are given in Table 4.4.3.3–4. For Pu destined for European MOX fabrication plant, the impacts include: transportation to the U.S. port; port handling at the U.S. port; ocean transport to European ports of Barrow, United Kingdom, and Cherbourg, France; ocean transport of MOX fuel back to the United States; and SST transport of MOX fuel from the port to either an existing (commercial) reactor site or storage site in the United States. In selecting transportation routes, including any ports, the safety of the public and security of the cargo are of primary consideration. To ensure these primary considerations are achieved, DOE would evaluate the ports to be used based on a set of criteria that would include adequacy of harbor and dock characteristics to satisfy the Pu container carrying ship requirements; adequacy of facilities for safe receipt, handling, and transhipment of Pu and MOX fuel; overall port security; availability of safe and secure lag storage; adequacy of overland transportation systems from ports to the reactor and from the Pu site(s); availability of a skilled labor force with routine experience in safe and secure handling of hazardous cargo; emergency preparedness status and response capabilities at the port and the nearby communities; quality of intermodal access for truck or rail shipments to and from the port; proximity to the proposed pit disassembly/conversion and reactor sites; local restrictions or regulations on movement of hazardous cargo; absence of significant environmental restrictions for the port; and the size of human population at the ports and along transportation routes. Port handling and global commons risks associated with the European MOX fuel fabrication option are discussed in Appendix G. [Text deleted.] The maximum risk impacts from the transport of Pu oxide, uranium oxide, and MOX fuel under the reactor alternatives are summarized in Table 4.4.3.3–4. Nonradiological accidents are the dominant risk for the Reactor Category of Alternatives. The highest number of total potential fatalities from the transportation of materials from lag storage (after pit disassembly/conversion or Pu conversion) to fuel fabrication and then to a reactor site is 4.16 for MOX fuel fabrication in the United States and a 4,000-km (2,485-mi) representative distance for each segment. The transportation risk for shipping MOX fuel from a domestic fabricator to an existing LWR is approximately the same as the transportation risk for shipping uranium-based fuel from a domestic fabricator to an existing LWR. Since the MOX fuel replaces the uranium-based fuel, the incremental transportation risk for the Existing LWR Alternative is only the risk of shipping the oxides to the MOX fuel fabrication site. Assuming a 4,000-km (2,485-mi) representative distance for each segment, the total potential facilities is 0.55. As shown in Table 4.4.3.3–4, using MOX fuel fabricated abroad would increase the transportation risk for this alternative. Under the Preferred Alternative, for analysis purposes, 70 percent of the surplus Pu would be sent to the pit disassembly/conversion facility and then to the MOX Fuel Fabrication Facility. Accordingly, the total potential fatalities for the Preferred Alternative would be lower than those shown in Table 4.4.3.3–4.

Reactor facilities are designed to accommodate spent nuclear fuel onsite, as described under waste management. The impacts of the future transport of DOE spent nuclear fuel, including both incident-free and accident conditions, are addressed in the DOE *Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F). That EIS concluded that the estimated number of fatalities from the operation of DOE spent nuclear fuel management facilities would not exceed 0.065 fatalities per year for transportation. Because the dominant risk in transporting radiological materials is nonradiological accidents, the fatalities from the transportation of spent LEU fuel assemblies will be similar to the transportation of spent MOX fuel assemblies. For analysis purposes in the Storage and Disposition PEIS, a maximum risk of 0.65 fatalities is used for transporting spent nuclear fuel to an HLW repository during the 10-year reactor operations period. This maximum risk for transportation of spent nuclear fuel has been added to each MOX total fatalities in Table 4.4.3.3–4.

Summary of Disposition Alternative Transportation Impacts.

A summary of the highest number of potential fatalities for each of the disposition alternatives is presented in Table 4.4.3.3–5. Based on the sites and environmental settings analyzed, none of the alternatives would exceed these values.

Table 4.4.3.3–4. Total Potential Fatalities From the Transportation of Plutonium Oxide, Uranium Oxide, and Mixed Oxide Fuel for the Reactor Category of Alternatives[a]

Representative Distance (km)	From Lag Storage Site to a U.S. MOX Fuel Fabrication Site	From Lag Storage Site to a European Port[b]	From a U.S. MOX Fuel Fabrication Site to a Reactor Site	From a European Port to a U.S. Reactor or Storage Site[b]
Plutonium Oxide				
1,000	0.102	0.132	NA	NA
2,000	0.188	0.218	NA	NA
4,000	0.359	0.389	NA	NA
Uranium Oxide				
1,000	0.060	0.087	NA	NA
2,000	0.104	0.131	NA	NA
4,000	0.193	0.221	NA	NA
Mixed Oxide Fuel				
1,000	NA	NA	1.07	1.47
2,000	NA	NA	1.91	2.31
4,000	NA	NA	3.61	4.01

[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] Port handling is evaluated separately as a facility risk. For the Preferred Alternative, the total potential facilities would be less. For analysis purposes, 70 percent of the surplus Pu would be sent to the pit disassembly/conversion facility and then to the MOX Fuel Fabrication Facility.

Note: Under the Preferred Alternative, for analysis purposes, 70 percent of the surplus Pu would be sent to the pit disassembly/conversion facility and then to the MOX fuel fabrication facility. Accordingly, the total potential fatalities for the Preferred Alternative would be lower than those shown in this table. NA=not applicable.

Source: RADTRAN model results.

Table 4.4.3.3–5. Highest Number of Potential Fatalities From the Transportation of Materials for Each Disposition Alternative[a]

Alternative	Highest Number of Potential Fatalities
Deep Borehole	
Direct Disposition	1.18
Immobilized Disposition	2.12
Immobilization	
Vitrification[e]	1.40
Ceramic Immobilization[e]	1.43
Electrometallurgical Treatment	0.923
Reactor	
Existing LWR[e]	5.65[b]
Partially Completed LWR	5.65[c]
Evolutionary LWR	5.65[c]
CANDU Reactor	5.00[d] [e]

[a] Highest potential number of fatalities from both radiological and nonradiological risks to the public and workers for the life of the project for both routine and accident conditions. Includes effects from the transport of Pu from existing storage sites to the pit disassembly/conversion site and Pu conversion site.

[b] Represents total fatalities for transportation with MOX fuel fabricated in the United States, shipped to a reactor in the United States, and the spent fuel shipped to a HLW repository. Because an existing LWR already has LEU fuel shipped to the site and would have spent fuel shipped from the site, the net incremental increase is 1.38 fatalities.

[c] Represents total fatalities for transportation with MOX fuel fabricated in the United States, shipped to a reactor in the United States, and the spent fuel shipped to a HLW repository.

[d] Represents total fatalities for transportation with MOX fuel fabricated in the United States and shipped to the Canadian border and does not include transportation impacts in Canada.

[e] Under the Preferred Alternative, for analysis purposes, approximately 30 percent of the total surplus Pu would be immobilized by either vitrification or ceramic immobilization, and the remaining highest surplus Pu would be used as MOX fuel in existing reactors. Accordingly, the highest number of potential fatalities for the Preferred Alternative would be lower than those for all the Reactor Alternatives.

Source: RADTRAN model results.

4.5 ENVIRONMENTAL JUSTICE IN MINORITY AND LOW-INCOME POPULATIONS

Pursuant to Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations,* this section identifies and addresses any disproportionately high and adverse human health or environmental effects on minority and low-income populations from activities described in previous sections of the PEIS. DOE is in the process of finalizing its Environmental Justice guidance. Because DOE is still in the process of developing guidance, the approach taken in this analysis may differ somewhat from whatever final guidance is eventually issued, and from the approach taken in other NEPA documents.

4.5.1 METHODOLOGY

Potential environmental justice impacts are assessed using a phased approach. This approach establishes four thresholds for assessing whether environmental justice issues are likely to arise as a result of proposed DOE activities. As described in DOE's draft guidance on incorporating environmental justice into the NEPA process, the following four questions form the framework and establish the thresholds for the phased approach to environmental justice analysis:

- Are there any potential impacts to human populations?
- Are there any potential impacts to minority populations or low-income populations?
- Are potential impacts to minority populations or low-income populations disproportionately high and adverse?
- Are any potential disproportionately high and adverse impacts "significant?"

Environmental Justice guidance developed by the Council on Environmental Quality (CEQ) defines "minority" as individual(s) who are members of the following population groups: American Indian or Alaskan Native, Asian or Pacific Islander, Black, not of Hispanic origin, or Hispanic (CEQ 1996a). Minority populations are identified when either the minority population of the affected area exceeds 50 percent or the percentage of minority population in the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographical analysis. Low-income populations are identified using statistical poverty thresholds from the Bureau of Census' Current Population Reports, Series P-60 on Income and Poverty.

Environmental justice impacts become issues of concern if the proposed activities result in disproportionately high adverse human and environmental effects to minority and low-income populations. Disproportionately high and adverse human health effects are identified by assessing these three factors to the extent practicable:

- Whether the health effects, which may be measured in risks or rates, are significant (as employed by NEPA) or above generally accepted norms. Adverse health effects may include bodily impairment, infirmity, illness, or death;
- Whether the risk or rate of exposure by a minority population or low-income population to an environmental hazard is significant (as employed by NEPA) and appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group; and
- Whether health effects occur in a minority population or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

Previous sections in Chapter 3 describe employment and income, population, housing, and community services surrounding each site. Income distribution is presented in this section. Impacts for each ROI from implementation of proposed alternatives are analyzed in Chapter 4. Selected ROI demographic characteristics for racial/ethnic minority groups and low income populations are presented in Tables 4.5.1–1 through 4.5.1–7. [Text deleted.]

Any disproportionately high and adverse human health or environmental effects on minority populations and low-income populations that could result from the storage and disposition alternatives being considered are assessed for an 80-km (50-mi) area surrounding each of the eight DOE sites. [Text deleted.] The shaded areas in Figures 4.5.1–1, 4.5.1–3, 4.5.1–5, 4.5.1–7, 4.5.1–9, 4.5.1–11, 4.5.1–13, and 4.5.1–15 show 1990 Census tracts for each DOE site where racial/ethnic minorities comprise 50 percent or more (simple majority) of the total population, or where minorities comprise less than 50 percent but greater than 25 percent of the total population in the Census tract. Figures 4.5.1–2, 4.5.1–4, 4.5.1–6, 4.5.1–8, 4.5.1–10, 4.5.1–12, 4.5.1–14, and 4.5.1–16 show low-income communities generally defined as those where 25 percent or more of the population is characterized as living in poverty (income of less than $8,076 for a family of two). Data on geographic distribution of low income and minority populations and prevailing wind conditions are used to assess whether toxic/hazardous pollutants and radiological releases from the proposed actions would be emitted disproportionately in the direction of these populations. This assessment is then used to identify whether any of the alternatives would cause disproportionately high and adverse effects to minority or low income populations in the vicinity of the sites.

Potential Impacts on Minority and Low-Income Populations From Subsistence Consumption of Fish and Wildlife

Section 4.4 of Executive Order 12898 directs Federal agencies, "whenever practical and appropriate, to collect and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence and that federal agencies communicate to the public the risks of these consumption patterns."

The potential environmental impacts of DOE activities on populations engaging in subsistence consumption could vary greatly depending on the precise location of a storage or disposition facility at a particular site, and the technology employed for the treatment or disposal of wastes at such a facility. In a prior NEPA review, incorporated herein by reference, DOE reviewed fish and wildlife consumption at Hanford, NTS, INEL, ORR, and SRS. At these sites, DOE found the potential impacts associated with the consumption of fish and wildlife to be small or to be no different than the potential impacts on the general population (DOE 1995v:5.20-11).

With regard to the impacts analyzed in this PEIS, and in the absence of subsistence consumption data by population sub-groups, DOE used the following criteria and assumptions, weighted in order of importance, to identify groups of sites that may be near minority and low-income populations potentially engaging in subsistence consumption:

- Proximity of Tribal Lands to DOE sites (the presence of Native Americans near DOE sites is assumed to create a greater possibility for subsistence consumption)
- Distance of the DOE site to major surface water bodies (populations nearer water are assumed to have a greater possibility of subsistence consumption of fish)
- Population density in the 80-km (50-mi) ROI around the site (rural residents are assumed to have a greater possibility of engaging in subsistence hunting and fishing)
- Proximity and concentration of minority and low-income populations to DOE sites (higher concentrations of minority and low-income populations are assumed to have a greater potential for subsistence consumption)

The eight DOE sites considered in this PEIS can be loosely categorized into three groups: those with the highest possibility for subsistence consumption, those with intermediate possibilities for subsistence consumption, and those with the lowest possibilities for subsistence consumption. Populations around more rural sites with recognized Native American groups are assumed more likely to engage in subsistence hunting and fishing. These sites include Hanford, INEL, LANL, and SRS. Although the areas around RFETS and NTS are more urban, these sites are of intermediate concern due to the presence of Native American populations or the presence of surface water onsite. ORR and Pantex are considered to have a lower possibility of populations who principally rely on fish and/or wildlife for subsistence, since there are no Federally recognized Native American groups around these two sites.

In order to assemble and disseminate information on subsistence hunting and fishing, DOE began publishing *A Department of Energy Environmental Justice Newsletter: Subsistence and Environmental Health* in the Spring of 1996. The three goals of the newsletter are (1) "to provide useful information about the health implications of consuming contaminated fish, wildlife, livestock products, or vegetation;" (2) "to provide information about projects and programs at DOE and other Federal and State agencies that address the problems associated with consuming contaminated fish, wildlife, livestock products, or vegetation;" and (3) "to receive relevant information from readers." In addition to the Newsletter, DOE has a new project underway to identify what information is being collected on subsistence consumption by other Federal agencies and to serve as a clearinghouse for such information.

In a recent article reviewing the literature on subsistence consumption, ANL found that (1) "the majority of the studies that have been conducted to date are focused on site- or region-specific exposure concerns...At present, it is unclear whether the findings of these studies are representative of consumption and exposure levels among minority populations at a national level;" (2) a large number of risk assessment studies focusing on fish and wildlife consumption examined whole populations without distinguishing between consumption and exposure patterns of specific ethnic (or other) subpopulations;" (3) "the vast majority of studies have focused on fish consumption as an exposure pathway. Few examined wildlife consumption and contamination, and even in such cases the studies were not motivated by minority exposure concerns;" and (4) "the majority populations to be significantly higher than for the population as a whole" (ANL 1994a:1).

4.5.2 Environmental Consequences

As seen in Figures 4.5.1–1 through 4.5.1–16, minority populations and low-income populations reside within 80 km (50 mi) of each of the DOE sites. The density and distribution of these populations vary from site to site with SRS and LANL having relatively large low-income populations and minority populations and NTS with relatively small low-income populations and minority populations within an 80-km (50-mi) radius of the site. Tables 4.5.1–1 through 4.5.1–8 provide demographic statistics for the ROIs used in the socioeconomic analysis.

For environmental justice impacts to occur, there must be high and adverse human health or environmental impacts that disproportionately affect minority populations or low-income populations. The public health and safety analysis shows that air emissions and hazardous chemical and radiological releases from normal operations for all storage and disposition alternatives would be within regulatory limits and that no latent cancer fatalities would result.

The public health and safety analyses also indicate that radiological releases from accidents would not result in significant adverse human health or environmental impacts. Therefore, such accidents would not have disproportionately high and adverse impacts on minority or low-income populations. For the Preferred Alternative, for accidents associated with existing reactors using MOX fuel, the maximum risk (which includes accident probability) of latent cancer fatalities to the public within 80 km (50 mi) would be 0.10 for the 11-year Pu disposition campaign. It is unlikely that there would be disproportionately high and adverse impacts to minority populations or low-income populations surrounding the existing reactors.

The Preferred Alternative would potentially combine different technologies and facilities at a number of sites. As discussed in Section 4.6, there would be no high or adverse impacts from routine operations or accidents, for such a combination of activities, that would disproportionately affect minority or low-income nonworker populations.

The environmental justice analysis also takes into account potential impacts to subsistence populations. However, DOE is unaware of any identified subsistence populations residing on or near any of the alternative sites.

The Department also notes that because none of the alternatives would lead to radiological releases to water that exceed Federal and State regulations, there would be no incremental impacts to fish or other edible aquatic life in the areas surrounding the alternative sites. All chemical releases would be regulated by NPDES permits and would be in compliance with Federal and State regulations. Furthermore, this PEIS evaluates doses to the surrounding population through air and liquid exposures for all alternatives, including No Action.

The analyses indicates that socioeconomic changes resulting from implementing any of the proposed alternatives would not lead to environmental justice impacts. Most alternatives would provide economic benefits through generating additional employment and income in the affected regions. At some sites there would be increased traffic congestion during facility construction or modification, however this impact would be temporary and would not disproportionately affect minority or low income communities. [Text deleted.] Regional income and employment would never decrease by more than one percent during phaseout, and at INEL, LANL, and Pantex, phaseout would have virtually no impact on either site or regional employment levels.

Transportation accidents are random occurrences that could potentially affect the population around the accident site. However, the random nature of these accidents precludes any disproportionate impact to minority or low income populations.

4.6 SUMMARY OF IMPACTS

The reasonable action alternatives analyzed in the PEIS are this Preferred Alternative, three long-term storage alternatives, and nine disposition alternatives (3 categories). The long-term storage alternatives, the disposition by immobilization alternative, and the Preferred Alternative all have suboptions or variants. In addition to these alternatives, the No Action Alternative has been analyzed for storage and disposition. The potential environmental impacts described in the following sections represent the impacts resulting from each alternative. Detailed explanations and the supporting data for the statements made and conclusions drawn are contained in Sections 4.1 through 4.5.

4.6.1 PREFERRED ALTERNATIVE IMPACTS

The Department's Preferred Alternative for storage and disposition is shown in Table 4.6.1–1. For long-term storage, DOE's Preferred Alternative is a combination of No Action, upgrade, and phaseout for the various DOE sites. For disposition of surplus Pu, the Preferred Alternative is a combination of reactor and immobilization alternatives.

Table 4.6.1–1. Storage and Disposition Actions at Department of Energy Sites Proposed by the Preferred Alternative

Action	Hanford	NTS	INEL	Pantex	ORR	SRS	RFETS	LANL
Storage								
No Action	X[a]	X[b]	X[a]					X[a]
Upgrade				X[c]	X[d]	X[e]		
Phaseout							X	
Disposition[f]								
Pit disassembly/conversion	X		X	X		X		
MOX fuel fabrication	X		X	X		X		
Pu conversion	X					X		
Immobilization	X					X		

[a] Pending subsequent tiered NEPA analysis for disposition of surplus Pu at these sites.
[b] NTS does not currently store either Pu or HEU.
[c] For storage of those pits currently at Pantex, pits from RFETS, and strategic reserve pits only.
[d] For storage of HEU only.
[e] For storage of only those Pu materials currently at SRS and non-pit Pu materials from RFETS.
[f] "X" denotes potential sites for locating the disposition facilities pending subsequent tiered NEPA decisions. Only one of each facility is needed for accomplishing the disposition mission.

Impacts from Storage Actions Under the Preferred Alternative

The Department's Preferred Alternative for the long-term storage of surplus Pu is a combination of No Action, upgrade, and phaseout for the various DOE sites. Table 4.6.1–2 shows the incremental operation requirements, public health risk, and waste generation that would result from the storage actions under the Preferred Alternative.

Land Resources. The implementation of the storage actions under the Preferred Alternative would have no additional impact to land resources and visual resources at all sites except Pantex. The upgrade actions at Pantex would require 0.1 ha (0.25 acre) of land. The amount of land required is a very small portion of the land available for development at the site. The proposed upgrade would be consistent with current and future land-use plans for the site.

*Table 4.6.1–2. **Incremental Impact Indicators Over No Action From the Annual Operation of the Storage Actions Under the Preferred Alternative***

	Hanford No Action	NTS No Action	INEL No Action	Pantex Upgrade[a]	ORR Upgrade	SRS Upgrade[b]	RFETS Phaseout	LANL No Action
Land area used (ha)	0	0	0	0.1	0	0	0	0
Water usage (MLY)	0	0	0	27.5	3	7.1	0	0
Maximum direct employment	0	0	0	90	111	130	-2179	0
Risk of fatal cancer for MEI from lifetime operation	0	0	0	4.5×10^{-13}	5.5×10^{-13}	2.1×10^{-10}	0	0
Solid TRU waste (m^3/yr)	0	0	0	0.8	0	0	0	0
Solid low-level waste (m^3/yr)	0	0	0	138	3	0	0	0
Solid hazardous waste (m^3/yr)	0	0	0	1.5	0.8[c]	0.8	0	0

[a] With RFETS pits.
[b] With RFETS non-pit materials.
[c] Data includes mixed LLW.

Site Infrastructure. The infrastructure at Pantex, ORR, and SRS would be capable of supporting the storage actions under the Preferred Alternative without major modifications. Any minor infrastructure modifications would have negligible impacts at these sites because they would most likely follow existing infrastructure base and rights-of-way.

Air Quality and Noise. Implementing the Preferred Alternative storage action at Pantex, ORR, and SRS would result in short-term air quality impacts during construction and negligible air quality impacts during operation. Modeled air emissions concentrations within applicable Federal, State, and local air quality standards and guidelines. Noise impacts would be negligible at all sites during construction and operation.

Water Resources. At Pantex, all water requirements for the upgrade would be supplied from existing onsite groundwater production wells. The construction and operation of the Upgrade Alternative would contribute to the continued depletion of the Ogallala Aquifer. Surface and groundwater resources at ORR and SRS are adequate to meet the additional requirements of the Preferred Alternative. Water resource impacts at ORR and SRS would be negligible.

Geology and Soils. The construction and operation of the storage actions under the Preferred Alternative would involve some ground disturbing activities with potential for soil erosion at Pantex and SRS. Using standard construction and erosion control measures soil impacts would be negligible. No other apparent direct or indirect effects on geologic resources are anticipated at any of the other DOE sites.

Biological Resources. Construction and operation of the storage actions under the Preferred Alternative would cause minimal disturbance to biological resources at Pantex, ORR, and SRS. All construction and operation activities would take place within an area that was previously disturbed. Minimal impacts to biological resources are expected at any of the other DOE sites as a result of the Preferred Alternative.

Cultural and Paleontological Resources. At Pantex, determinations of NRHP-eligible Cold War Era structures have not yet been completed, but none of the structures that would be modified under the Upgrade Alternative are currently considered NRHP eligible. At ORR, four buildings that are part of the proposed Y–12 Plant

National Register Historic District would be modified under the Preferred Alternative. The Preferred Alternative would not be expected to impact cultural and Paleontological resources at the rest of the DOE sites.

Socioeconomics. At Pantex and SRS, the upgrade would require a small number of additional workers for construction and operation. The small increase in employment would have negligible impact to the regional economy. At RFETS, phaseout of Pu storage would result in the loss of 2,197 direct jobs. Compared to the total employment in the area, the loss of these jobs and the impacts to the regional economy would not be severe. Minimal socioeconomic impacts are expected at the other DOE sites as a result of the Preferred Alternative.

Public and Occupational Health and Safety. The Upgrade Alternative under the Preferred Alternative would increase the amount of Pu stored at Pantex and SRS; increased doses to the public would be negligible. At ORR, doses to the public from upgraded storage would be virtually the same as for storage under No Action. At RFETS, the phaseout of Pu storage would reduce the impacts from radiological and chemical releases and exposure to levels slightly below the No Action levels for normal operations. Stabilization and packaging activities at RFETS would have short-term minor increases in exposure to workers associated with the transport of the Pu. The potential worker exposures would not exceed applicable health and safety regulatory standards. No impacts are expected at the other DOE sites as a result of the Preferred Alternative.

Waste Management. The construction and operation of the storage actions under the Preferred Alternative at Pantex, ORR, and SRS would have an impact on existing waste management activities. Additional wastewater and nonhazardous and hazardous solid waste would be generated at these sites. Hazardous waste would be shipped offsite to a commercial RCRA-permitted treatment and disposal facility. Existing waste handling practices would be used for additional nonhazardous wastes from the new facilities. No waste management impacts are expected at the other DOE sites as a result of the storage action under the Preferred Alternative.

Environmental Justice. The air emissions and hazardous chemical and radiological emissions from normal operations of the storage actions under the Preferred Alternative would be within regulatory limits at all sites. Therefore, there would be no disproportionate impacts to any low income or minority populations at any of the site's due to normal operations. The public health and safety analyses show that air emissions and hazardous chemical and radiological releases from normal operations for the Preferred Alternative storage facilities would be within regulatory limits and that no latent cancer fatalities would result. Because no populations within 80 km (50 mi) of the proposed site would experience high or adverse health or environmental impacts, neither minority populations nor low-income populations would experience disproportionate high and adverse human health or environmental impacts.

The public health and safety analyses also indicate that radiological releases from accidents would not result in significant adverse human health or environmental impacts. Therefore, such accidents would not have disproportionately high and adverse impacts on minority or low-income populations. Potential transportation accidents would be random events along the transportation corridors, therefore, such accidents would not disproportionately impact minority or low income populations.

Intersite Transportation. Potential intersite transportation impacts could occur for transportation of RFETS material to Pantex and because of the small increased risk of traffic accident fatalities. Intersite transportation impacts would primarily be the result of nonradiological impacts such as fatalities from nonradiological highway accidents. The total potential fatalities from the transportation of material under the Preferred Alternative would be 0.006 for Pantex and 0.06 for SRS.

Impacts from Storage and Disposition Actions Under the Preferred Alternative

This section identifies the maximum site impacts that would result at Hanford, INEL, Pantex, and SRS from combining the Preferred Alternative for storage with the Preferred Alternative for disposition at each site. Total site impacts associated with No Action for NTS and LANL, and with phaseout at RFETS, are described in

Section 4.2. The impacts from operating most of the existing reactors would not affect DOE sites and are described in Section 4.3.5. To the extent practical, DOE would use existing buildings and facilities for portions of the disposition activities. The use of existing buildings would reduce the impacts identified in this section. DOE would analyze and compare existing and new buildings for the technologies chosen as part of the Preferred Alternative in subsequent, tiered NEPA reviews.

The preferred strategy for disposition is a combination of reactor and immobilization alternatives. For purposes of analysis, approximately 70 percent of the surplus Pu, which is high purity material, would be converted into MOX fuel for use in nuclear reactors. The Preferred Alternative identifies the use of existing reactors. The Department would retain using MOX fuel in Canadian CANDU reactors in the event of a multilateral agreement among Russia, Canada, and the United States. Low purity Pu would be immobilized in glass or ceramic forms (approximately 30 percent for analysis purposes only). Disposition by use in reactors would require the construction of a MOX fuel fabrication facility and a pit disassembly/conversion facility at a DOE site. Disposition by immobilization would require the construction of a Pu conversion facility and an immobilization facility (either ceramic immobilization or vitrification) at a DOE site. DOE has identified four DOE sites in Table 4.6.1–1 as potential locations for MOX fuel fabrication and pit disassembly/conversion facilities, and two sites for the Pu conversion and immobilization facilities.

The following sections describe the total impacts that would result from the implementation of the Storage and Disposition Program Preferred Alternative at the four DOE sites identified for potential placement of the disposition facilities. The analysis conservatively assumed a maximum impact scenario where two or four disposition facilities could be placed at the same DOE site as shown in Table 4.6.1–1. For immobilization, the analysis conservatively uses impacts from the ceramic immobilization facility since they are generally larger than the impacts from the vitrification facility.

Land Resources. The land-use requirements associated with construction and operation of the Preferred Alternative actions at Hanford, INEL, Pantex, and SRS are shown in Table 4.6.1–3. The requirements shown in Table 4.6.1–3 are the maximum impacts if multiple disposition facilities were located at the same site. Collocating the disposition facilities at a site would likely reduce the amount of land-use impacts due to the sharing of land resources. In addition, optimal use of existing buildings and facilities would occur where possible. All four sites would have adequate land area to accommodate the facilities. Most disposition facilities would be sited in a 1.6-km (1-mi) buffer zone contained within the site boundary. This section describes the impacts to land resources from constructing and operating the Preferred Alternative storage and disposition facilities for each site.

For all four DOE sites, construction and operation would not affect other onsite or offsite land uses. No prime farmlands exist onsite. Construction and operation would be compatible with State and local land-use plans, policies, and controls. Hanford provides information to local jurisdictions for use in their efforts to comply with the GMA.

Hanford Site. Plutonium materials would continue to be stored at the PFP in the 200 West Area, pending decisions on their disposition. No impacts to land-use or visual resources are expected. The pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would be located on vacant land in the 200 Area adjacent to 200 East. Construction and operation of the facilities would conform to existing and future land use as described in the *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.

Construction and operation would be consistent with the industrialized landscape character of the 200 Area and with the current VRM Class 5 designation. A potential source of visual impacts during operation of the ceramic immobilization facility or MOX facility would be the stack plumes that could be visible from public viewpoints

Table 4.6.1–3. Land-Use Requirements From the Preferred Alternative

Action	Area of Disturbance (ha)			
	Hanford	INEL	Pantex	SRS
Construction				
Storage	0.0	0.0	0.18	0.0
Pit disassembly/conversion	14	14	14	14
Pu conversion	36	NA	NA	36
MOX fuel fabrication	121	121	121	121
Ceramic immobilization	20	NA	NA	20
Total (Maximum Impact)	191	135	135.18	191
Operation				
Storage	0.0	0.0	0.1	0.0
Pit disassembly/conversion	12	12	12	12
Pu conversion	28	NA	NA	28
MOX fuel fabrication	81	81	81	81
Ceramic immobilization	12	NA	NA	12
Total (Maximum Impact)	133	93	93.1	133

Note: NA=not applicable.

Source: Section 4.2.1.1; Section 4.2.3.1; Section 4.3.4.1; Section 4.2.6.1; Section 4.3.1.1; Section 4.3.2.1; Section 4.3.4.2.1; Section 4.3.5.1.1.

with high sensitivity levels, including State Highways 24 and 240 and the city of Richland; however, the proposal would be compatible with the existing industrial character of the area.

Idaho National Engineering Laboratory. Pu materials would continue to be stored at the ICPP and at ANL-W in the ZPPR and FMF vaults, pending decisions on their disposition. No impacts to land-use or visual resources are expected. The pit disassembly/conversion and MOX facilities would be located on undeveloped land within or near the ICPP security area. Construction and operation would be consistent with the *Idaho National Engineering Laboratory Site Development Plan*, which designates the ICPP as situated within the central core area/Prime Development Zone at INEL.

Construction and operation would be consistent with the industrialized landscape character of the ICPP and with the current VRM Class 5 designation. A potential source of visual impact during operation of the MOX facility would be from the stack plumes that could be visible; however, the proposal would be compatible with the existing industrial character of the area.

Pantex Plant. Buildings 12-66 and 12-82 in Zone 12 South would be modified to accommodate the long-term storage of Pantex Pu material and RFETS pit Pu material for the storage Preferred Alternative. Construction and operation would conform with the *Pantex Site Development Plan*, which includes as part of its master plan the Fissile Material Storage Facility in Zone 12. Zone 12 is also the potential location for the pit disassembly/conversion facility. Construction and operation would conform with the *Pantex Site Development Plan*, which designates Zone 12 for weapon assembly/disassembly. The MOX fuel fabrication facility would be located on undeveloped land in Zone 11, which is designated for applied technology. However, Pantex could revise the site development plan. If this change were approved, the proposed MOX facility would be in compliance, resulting in no impact.

The proposed visual environment of Zone 12 would be compatible with the existing industrialized landscape character and the current VRM Class 5 designation would remain. A potential source of visual impacts during operation of the MOX facility in Zone 11 would be the stack plumes that could be visible; however, the proposal would be compatible with the existing industrial character of the area.

Savannah River Site. The APSF in F-Area would be modified to accommodate the long-term storage of SRS non-pit Pu material and RFETS non-pit Pu material for the Preferred Alternative. Vacant land in the F-Area would be used for the pit disassembly/conversion, Pu conversion, and ceramic immobilization facilities. 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. 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. Construction and operation would conform with future land use as designated by the *Savannah River Site Development Plan*. According to the Plan, the future land-use category for the proposed development site is primary industrial mission. Although the proposal would convert undeveloped land, forested land, and a very small portion of NERP lands, due to conformance of the proposed MOX fuel fabrication facility would conform with site land-use plans.

Construction and operation of the upgrade storage, pit disassembly/conversion, Pu conversion, and ceramic immobilization facilities would be consistent with the industrial landscape character and current VRM Class 5 designation of the F-Area. Construction and operation of the MOX facility would change the current VRM Class 4 designation of the site north of the P-Reactor Area to Class 5. Potential visual impacts could occur during operation of the ceramic immobilization and MOX facilities from additional stack plumes; however, because of hilly terrain, visual effects to public access roads with high sensitivity levels would not occur.

Site Infrastructure. The resource requirements for the construction of the proposed facilities are not expected to exceed site capabilities. Operational requirements from the Preferred Alternative at all sites analyzed are shown in Table 4.6.1–4. The planned facilities use natural gas as the primary utility fuel, and the total requirement for natural gas would be larger than currently available at Hanford, INEL, and SRS. Since INEL and SRS use fuel oil as the primary utility fuel, use of natural gas in lieu of fuel oil would require additional infrastructure. Final designs for facilities under the Preferred Alternative at INEL and SRS would be adapted to use fuel oil. Additional oil and natural gas requirements could be procured through normal contractual means at all sites. Locating the Preferred Alternative disposition actions at any of the analyzed sites would require the construction of additional roads and rail.

Air Quality and Noise. Construction and operation of the proposed facilities under the Preferred Alternative would generate criteria and toxic/hazardous air pollutants. To evaluate potential air quality impacts at Hanford, INEL, Pantex, and SRS, potential concentrations from the facilities have been compared to Federal and State guidelines in Table 4.6.1–5.

Concentrations of PM_{10} and TSP are expected to increase during construction of the facilities. Simultaneous construction of the facilities could result in elevated levels of these pollutants. However, appropriate control measures would be used to control fugitive emissions. It is expected that the sites would typically comply with applicable Federal and State ambient air quality standards during construction.

The PSD regulations, which are designed to protect ambient air quality in attainment areas, apply to new sources and major modification to existing sources. Based on emission rates presented in Appendix F, PSD permits may be required at all of the sites under consideration for the preferred alternative facilities. PSD permits may require inclusion of "offsets" (reductions of existing emissions) for any additional or new emission source.

During operation, concentrations of criteria and toxic/hazardous air pollutants are expected to be in compliance with Federal, State, and local air quality regulations and guidelines at all of the sites analyzed. The estimated pollutant concentrations for the preferred alternative facilities, plus the No Action concentrations, are presented in Table 4.6.1–5.

Noise sources associated with the preferred alternative facilities may include construction equipment, increased traffic, ventilation equipment, cooling systems, and emergency diesel generators. The contribution to offsite noise levels would continue to be small at all of the sites because the facilities associated with the Preferred Alternative would be a sufficient distance away from the site boundary and sensitive receptors. Due to the size of the sites, noise emissions from construction and operation activities would not be expected to cause annoyance to the public. Some noise sources may result in the disturbance of wildlife.

Water Resources. The construction and operation of the proposed facilities under the Preferred Alternative would affect water resources. Table 4.6.1–6 shows the estimated water usage and wastewater generation from the Preferred Alternative at Hanford, INEL, Pantex, and SRS. All facilities would be constructed outside of the 100-year, 500-year, and probable maximum floodplain; although, where the 500-year floodplain is not completely mapped at SRS, the facility would likely be located outside of the 500-year floodplain. Flooding from dam failures and flooding from a landslide resulting in river blockage are not expected to occur where applicable. The wastewater discharges are expected to continue to meet NPDES limits and reporting requirements at all sites.

Hanford Site. Surface water obtained from the Columbia River would be used as the water source for operation of the proposed facilities. The total water requirement for the Preferred Alternative at Hanford would be less than 1 percent of the Columbia River's average annual flow (3,360 m^3/s [118,642 ft^3/s]). The withdrawals are minor in comparison with the average flow of the river and would not noticeably affect the local or regional water supply.

Table 4.6.1–6. Potential Changes to Water Resources Resulting From the Preferred Alternative

Affected Resource Indicator	Hanford	INEL	Pantex	SRS
Water Source	Surface	Ground	Ground	Ground
No Action water requirement (million l/yr)	13,511	7,570	249	13,247
No Action wastewater discharges (million l/yr)	246	540	141	700
Construction				
Water availability and use				
Total water requirement (million l/yr)	44.2	3.8	3.86	47.2
Storage alternative (million l/yr)	0[a]	0[a]	0.06[b]	3[c]
Pit disassembly/conversion facility (million l/yr)	1.9	1.9	1.9	1.9
Plutonium conversion facility (million l/yr)	2.4	NA	NA	2.4
MOX fuel fabrication facility (million l/yr)	1.9	1.9	1.9	1.9
Ceramic immobilization alternative (million l/yr)	38	NA	NA	38
Percent increase in projected water use[d]	0.33	0.05	1.55	0.36
Water quality				
Total wastewater discharge (million l/yr)	35	3.8	6.9	37.4
Storage alternative (million l/yr)	0[a]	0[a]	3.1[b]	2.4[c]
Pit disassembly/conversion facility (million l/yr)	1.9	1.9	1.9	1.9
Plutonium conversion facility (million l/yr)	2.4	NA	NA	2.4
MOX fuel fabrication facility (million l/yr)	1.9	1.9	1.9	1.9
Ceramic immobilization alternative (million l/yr)	28.8	NA	NA	28.8
Percent increase in wastewater discharge[e]	14.23	0.70	4.89	5.34
Percent increase in stream flow	neg	NA	NA	0.74[f]
Operation				
Water availability and use				
Total water requirement (million l/yr)	481.9	151.4	178.9	489
Storage alternative (million l/yr)	0[a]	0[a]	27.5[b]	7.1[c]
Pit disassembly/conversion facility (million l/yr)	94.6	94.6	94.6	94.6
Plutonium conversion facility (million l/yr)	80.5	NA	NA	80.5
MOX fuel fabrication facility (million l/yr)	56.8	56.8	56.8	56.8
Ceramic immobilization alternative (million l/yr)	250	NA	NA	250

Table 4.6.1–6. Potential Changes to Water Resources Resulting From the Preferred Alternative—Continued

Affected Resource Indicator	Hanford	INEL	Pantex	SRS
Percent increase in projected water use[g]	3.57	2.00	71.85	3.69
Water quality				
Total wastewater discharge (million l/yr)	241.7	128.7	141.6	243.5
Storage alternative (million l/yr)	0[a]	0[a]	12.9[b]	1.8[c]
Pit disassembly/conversion facility (million l/yr)	85.2	85.2	85.2	85.2
Plutonium conversion facility (million l/yr)	15	NA	NA	15
MOX fuel fabrication facility (million l/yr)	43.5	43.5	43.5	43.5
Ceramic immobilization alternative (million l/yr)	98	NA	NA	98
Percent increase in wastewater discharge[h]	98.25	23.83	100.4	34.79
Percent increase in stream flow	neg	NA	NA	4.83[f]
Floodplain				
Is action in 100-year floodplain?	No	No	No	No
Is critical action in 500-year floodplain?	No	No	No	Unlikely

[a] Zero values indicate No Action Alternative for storage at Hanford and INEL.
[b] Value represents upgrade without RFETS and LANL material.
[c] Value represents a conservative assumption for SRS to receive all RFETS and LANL Pu material as opposed to non-pit Pu material only.
[d] Percent increases in water requirements during construction of the proposed facilities are calculated by dividing water requirements for the facility by No Action water requirements at each analyzed site.
[e] Percent increases in wastewater discharged during construction of the proposed facilities are calculated by dividing wastewater discharges for the facility by No Action discharge at each analyzed site.
[f] Percent change in stream flow from wastewater discharges is calculated from the minimum flow of the Fourmile Branch (0.16 m^3/s).
[g] Percent increases in water requirements during operation of the proposed facilities are calculated by dividing water requirements for the facilities by No Action water requirements at each analyzed site.
[h] Percent increases in wastewater discharged during operation of the proposed facilities are calculated by dividing wastewater discharges for the facilities by No Action discharge at each analyzed site.

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: Table 4.2.4.4–1; Table 4.2.6.4–1; Table 4.3.1.4–1; Table 4.3.2.4–1; Table 4.3.4.2.4–1; Table 4.3.5.1.4–1.

The wastewater would be disposed to newly constructed sanitary, utility, and process wastewater treatment systems. The wastewater discharge would account for a 98-percent increase over the No Action Alternative projected discharge.

Idaho National Engineering Laboratory. Water requirements for the operation of the Preferred Alternative at INEL would be obtained from groundwater sources. The water requirements for the site over the projected No Action water usage would be a 2-percent increase for operations (approximately 9.6 percent of the groundwater allotment) and less than a 0.05-percent increase for construction (approximately 0.24 percent of the groundwater allotment).

The wastewater discharged during operations would be a 24-percent increase over the No Action projected discharge. Existing INEL treatment facilities could accommodate all the new Preferred Alternative processes and wastewater streams. However, if necessary, new sanitary, utility, and process wastewater treatment systems would be constructed.

Pantex Plant. Water requirements for the operation of the Preferred Alternative at Pantex would be obtained from groundwater resources or, if feasible, from the City of Amarillo Hollywood Road Wastewater Treatment Plant. Should only groundwater be used, the total annual site groundwater withdrawal, including the Preferred Alternative in the year 2005 (the No Action base year), would be 428 million l/yr (112 million gal/yr). This represents a 72-percent increase in the projected No Action usage. However, because the projected No Action usage reflects reductions in water use due to planned downsizing over the next few years, this quantity (No Action plus the Preferred Alternative) is considerably less than what is currently being withdrawn at Pantex (836 million l/yr [221 million gal/yr]). Although Pantex's groundwater usage is expected to decline in the future, the site will still contribute to the declining water levels of the Ogallala Aquifer.

Total estimated wastewater discharge for the Preferred Alternative (283 million l/yr [74.7 million gal/yr]) at Pantex would result in a 100-percent increase in the No Action projected discharge. If necessary, new sanitary, utility, and process wastewater treatment systems would be constructed.

Savannah River Site. Water requirements during operation of the Preferred Alternative would be obtained from existing or new well fields at SRS. The Preferred Alternative water requirements for the site would be a 3.7-percent increase over projected No Action groundwater usage. Suitable groundwater from the deep aquifers at the site is abundant, and aquifer depletion is not a problem.

The Preferred Alternative wastewater discharge to the river would be less than 5 percent of the minimum flow of Fourmile Branch (0.16 m^3/s [5.7 ft^3/s]), and less than 0.003 percent of the Savannah River average flow (282 m^3/s [9,960 ft^3/s]). SRS treatment facilities could accommodate all the new processes and wastewater streams if a new facility is built for tritium supply and recycling operations as planned. However, if necessary, new sanitary, utility, and process wastewater treatment systems would be constructed.

Geology and Soils. The construction of the proposed facilities under the Preferred Alternative would involve some ground disturbing activities at Hanford, INEL, Pantex, and SRS. Ground disturbance increases the potential for soil erosion. The key factors affecting the erosion potential of a site are the amount of disturbed land and the amount of annual precipitation. The amount of land disturbed as a result of the Preferred Alternative facilities is shown in Table 4.6.1–3. The potential for soil erosion at Hanford, INEL, and Pantex is slight because of low precipitation. Since SRS receives more precipitation, the potential for erosion is considered moderate. The amount of soil loss would depend on the frequency and severity of precipitation events, wind velocities, and the size, location, and duration of soil disturbance.

During operation, improvements (buildings, roads, and landscaping) would considerably reduce the erosion potential. Erosion from stormwater runoff and wind could occasionally occur during operation of the facilities. Beyond increased erosion potential, no direct or indirect effects on geologic resources are anticipated. The construction and operation of the facilities and the site infrastructure improvements would not restrict access to potential geologic resources.

Biological Resources.

Hanford Site. Pu materials would continue to be stored at the PFP in the 200 West Area. There would be no impacts on biological resources anticipated. The pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would be constructed on vacant land in the 200 Area adjacent to 200 East. Construction of the four disposition facilities would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Noise from construction and operation activities 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 were below its carrying capacity, these animals would be expected to survive. However, if the area were 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 excess population. Nests and young animals living within the assumed sites may not survive. The sites 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.

Construction and operation of the four disposition facilities would not affect wetlands or aquatic resources since no wetlands or surface water bodies exist near the assumed facilities locations. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure, and wastewater would be discharged to evaporation/infiltration ponds. Wetlands or aquatic resources bordering the river would not be affected because the volume of water included represents a small percentage of the flow of the river.

It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the four disposition facilities, but sagebrush habitat would be disturbed. The sagebrush community is an 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, and sage thrasher. Pre-activity surveys would be conducted as appropriate before construction to determine the occurrence of plant species or animal species and habitat in the area to be disturbed. DOE would also consult with Federal and State agencies pursuant to the ESA and other statutes, as appropriate.

Idaho National Engineering Laboratory. Pu materials would continue to be stored at the ICPP and at ANL-W in the ZPPR and FMF vaults. There would be no impacts on biological resources anticipated. The pit disassembly/conversion and MOX facilities would be located on undeveloped land within or near the ICPP security area. The ICPP area falls within the big sagebrush/thickspike wheatgrass/needle-and-thread grass community. Construction of the two disposition facilities would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Noise from construction and operation activities 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 were below its carrying capacity, these animals would be expected to survive. However, if the area were 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 excess population. Nests and young animals living with the assumed sites may not survive. The sites 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.

Wetlands and aquatic resources associated with the nearest surface water body, the Big Lost River, are located 1.6 km (1 mi) from the facility location, so impacts are not expected there. Due to the lack of wetlands or aquatic resources at the assumed facility locations, these resources would not be affected by construction or operation of the two facilities.

It is unlikely that federally threatened or endangered species would be affected by construction of the two disposition facilities, but several State-listed species may be affected. 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 through 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 before construction to determine the occurrence of these species in the area to be disturbed. DOE would also consult with Federal and State agencies pursuant to the ESA and other statutes, as appropriate. No impacts to threatened and endangered species are expected due to facility operation.

Pantex Plant. Buildings 12-66 and 12-82 in Zone 12 South would be modified to accommodate the long-term storage of Pantex Pu material and RFETS pit Pu material. Upgrading the existing storage Pu storage facility at Pantex would cause minimal disturbance to biological resources because all activities, including some new construction, would take place within the developed area. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the developed area have already adapted to its presence. Impacts to wetlands and aquatic resources would not occur since these resources are not found in the upgrade area. Since the upgrade would take place within a developed area, impacts to threatened and endangered species would not be expected.

Zone 12 is also the potential location for the pit disassembly/conversion facility. The MOX fuel fabrication facility would be located on undeveloped land in Zone 11, which lacks natural vegetation. Disturbance to wildlife would be limited due to the disturbed nature of the assumed locations; however, small mammals and some birds and reptiles could be displaced by construction. Since the area around both locations 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 site playas through NPDES-regulated outfalls. The additional wastewater could lead to minor increases in open water near the outfalls, as well as changes in plant species composition. It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of the facilities. Although the assumed sites have been disturbed, it is possible that the State-listed Texas horned lizard could be present. Before construction, preactivity surveys would be conducted, as appropriate, to determine the presence of any special status species and habitat on the proposed site. DOE would also consult with Federal and State agencies pursuant to the ESA and other statutes, as appropriate.

Savannah River Site. The APSF in F-Area would be modified to accommodate the storage of RFETS non-pit Pu material in addition to SRS non-pit Pu material. There would be minimal additional impacts on biological resources anticipated with modifying the APSF in F-Area.

Vacant land in the F-Area would be used for the pit disassembly/conversion, Pu conversion, and ceramic immobilization facilities. Impacts to terrestrial resources would be minimal because the F-Area is one of the highly developed industrial areas of the SRS. 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 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 there would be relatively small increases in treated wastewater and stormwater that would be discharged via NPDES permitted outflows. Impacts from construction and operation of the three disposition facilities would not be expected to affect threatened and endangered species due to the developed nature of the assumed facility locations. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the facilities so that this species would not be directly affected by these facilities. Before committing construction resources, DOE would consult with Federal and State agencies pursuant to the ESA and other statutes, as appropriate.

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. 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. Noise from construction and operation activities 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 were below its carrying capacity, these animals would be expected to survive. However, if the area were 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 excess population. Nests and young animals living with the assumed sites may not survive. The sites 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.

Since the majority of the assumed MOX fuel fabrication facility site is upland, the facility could be located to avoid direct impacts to wetlands. It would not be necessary to disturb wetlands along the site streams. Wastewater discharge from construction and operation would be minimal and would not be expected to affect wetlands associated with the receiving stream. Stormwater runoff during construction could cause temporary water quality changes in local tributaries to Par Pond. 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 regulations.

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 highly 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 facilities so that this species would not be directly affected by the MOX facility, Before construction, preactivity surveys would be conducted as appropriate to determine the presence of any special status species and habitat on the proposed site. DOE would also consult with Federal and State agencies pursuant to the ESA and other statutes, as appropriate.

Cultural and Paleontological Resources. The potential impacts to cultural and paleontological resources are closely related to the amount of land disturbed. The land-use requirements associated with construction and operation of the Preferred Alternative actions at Hanford, INEL, Pantex, and SRS are shown in Table 4.6.1–3. Collocating the disposition facilities at a site would likely reduce the amount of land disturbed during construction and reduce the impacts to cultural and paleontological resources. In addition, optimal use of existing buildings and facilities would occur where possible. Because most of the locations proposed have been previously disturbed (except at SRS), it is unlikely that they would contain subsurface prehistoric or historic archaeological deposits. Some paleontological remains may be encountered during construction. Operations would not have additional impacts on historic, prehistoric, or paleontological resources, but there may be visual or auditory intrusions to Native American resources at some site. This section describes the impacts to cultural and paleontological resources of constructing and operating the storage and disposition facilities for each Preferred Alternative site.

Hanford Site. Pu materials would continue to be stored at the PFP in the 200 West Area. For the storage Preferred Alternative, there would be no anticipated impacts to cultural or paleontological resources. The pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would be located on vacant land in the 200 Area adjacent to 200 East. Although no archeological resources have been identified during surveys conducted in the adjacent 200 Areas, some may exist in the facility locations. Any such sites would be identified through compliance with Sections 106 and 110 of the NHPA. Any identified sites may be affected by facility construction. Operation would not result in additional impacts.

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 Area. Resources may be identified through facility-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 facility locations, they may exist. These resources may be affected by ground disturbing construction. Operations would not have additional impacts on paleontological resources.

Idaho National Engineering Laboratory. Pu materials would continue to be stored at the ICPP and the ZPPR and FMF vaults in ANL-W. For the storage Preferred Alternative, there would be no anticipated impacts to cultural or paleontological resources. The pit disassembly/conversion and MOX facilities would be located on undeveloped land within or near the ICPP security area. The pit disassembly/conversion facility would be sited in a location previously approved for the construction of the Special Isotope Separation Project. A surface survey of this area identified no prehistoric or historic 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 archeological 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 facilities. Facility construction and operation may have visual or auditory impacts 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. Buildings 12-66 and 12-82 in Zone 12 South would be modified to accommodate the long-term storage of Pantex Pu material and RFETS pit Pu material for the storage Preferred Alternative. These buildings are not considered NRHP eligible based on an evaluation of World War II Era structures at Pantex. However determinations of NRHP-eligible Cold War Era structures have not been completed, and some structures in Zone 12 may be determined eligible on that basis. Zone 12 is also the potential location for the pit disassembly/ conversion facility. Because Zone 12 South is developed, disturbed, and removed from water sources, it is unlikely to contain subsurface prehistoric or historic archeological deposits, even on lands used for equipment laydown or construction parking. No impacts to prehistoric or historic resources are expected to result from the construction or operation of these facilities.

The MOX fuel fabrication facility would be located on undeveloped land in Zone 11. Areas that would be disturbed in Zone 11 have not been systemically surveyed for archaeological or paleontological resources. Before construction, additional survey work may be necessary under Section 106 of the NHPA. Because Zone 11 is disturbed, it is unlikely to contain subsurface prehistoric or historic archeological deposits. Should any subsurface remains be discovered during construction, appropriate mitigation, documentation, and/or preservation measures would be conducted as necessary. Operations would not have additional impacts to archeological resources as it does not result in additional ground disturbance. Facility construction may have an impact on historic structures at Pantex. The original buildings in Zone 11 were constructed between 1942 and 1945 to produce general purpose bombs. Zone 11 contains buildings, ramps, and landscape features that 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.

The Department 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 Zones 11 and 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 considered important Native American resources. 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 affect on paleontological resources.

Savannah River Site. The APSF in F-Area would be modified to accommodate the storage of SRS non-pit Pu material and RFETS non-pit Pu material for the storage Preferred Alternative. Vacant land in the F-Area would be used for the pit disassembly/conversion, Pu conversion, and ceramic immobilization facilities. Portions of the 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 to comply with NHPA Sections 106 and 110. 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.

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. 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 may be affected by construction and operation of the facilities. Resources such as prehistoric sites, cemeteries, isolated burials, 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 the areas may also result from the proposed facilities. These resources would be identified through consultation with the potentially affected tribes.

Some paleontological remains may occur on this acreage, but impacts during construction would be considered negligible because fossil assemblages known to occur at SRS are of low research value. No additional impacts are expected to paleontological resources during operation since no additional ground disturbance is expected.

Socioeconomics. The socioeconomic impact indicators associated with construction and operation of the Preferred Alternative actions at Hanford, INEL, Pantex, and SRS are shown in Table 4.6.1–7. The maximum impacts that could result from the operating of multiple storage and disposition facilities at one site are shown in the table. Although collocating multiple disposition facilities would likely lead to economies of scale, the ensuing analysis assumes that there would be no sharing of labor resources among the different operations. At all four sites the primary impact of the Preferred Alternative would be to increase regional employment and income. There would be some increase in demand for community services and housing at each of the sites as a result of in-migrating population. However, the available housing and existing community infrastructure would be able to accommodate these small population increases. Construction and operation of the proposed facilities would increase traffic flow and cause a potential decline in the level of service on some road segments at all sites except Hanford.

Table 4.6.1–7. Changes to Economic and Demographic Indicators for the Preferred Alternative (Full Operation)

Indicator	Hanford	INEL	Pantex	SRS
Change in ROI population	5,095	2,125	4,298	6,153
Percent change in ROI population	1.1	0.9	2.0	1.2
Change in REA employment	10,370	5,998	6,404	9,482
Percent change in REA employment	2.8	3.8	2.9	3.3
Change in REA per capita income	$464	$266	$94	$326
Percent change in REA per capita income	2.0	1.4	0.5	1.6

Source: Socio 1996a.

Hanford Site. Plutonium materials would continue to be stored at the PFP in the 200 West Area, and there would be no impact on the site workforce. However, under the Preferred Alternative, pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would also be located at Hanford. Construction of the various facilities would continue through the year 2013, and there would be sufficient available labor within the region to fulfill construction workforce requirements. Economic impacts from construction would peak in 2010, during construction of the ceramic immobilization facility. Total REA employment would increase by 2,001 due to construction of the ceramic immobilization facility. However, during this same period, the other three disposition facilities would already be fully operational, generating an additional 7,467 jobs in the REA.

In 2003, the pit disassembly/conversion and MOX facilities would be the first disposition alternative facilities to become fully operational. Pu conversion would begin in 2006, and the ceramic immobilization operations would begin in 2013. The operational workforce would increase beginning in 2003 and peak in 2013 when all of the disposition facilities would become fully operational. Total direct employment would reach 3,073 in 2013. Total REA employment would increase by 10,370, and unemployment would decrease from 9.1 percent to 7.1 percent. The per capita income would increase by 2 percent. In-migration to fulfill specialized direct job requirements would lead to a population increase of about 1 percent in the ROI.

The additional population would increase the demand for community services by approximately 1 percent. A total of about 50 new teachers would be needed by 2013. Because the increase in demand would occur over a 10-year period and would be distributed over several school districts, there would be no significant impact on any single district. Thirteen additional police officers and seven firefighters would be needed to maintain No Action service levels. Six more doctors would be needed to maintain the projected No Action doctor-to-population ratio. In each case, the increase would be 1 percent or less over the No Action Alternative. Demand for housing would also increase, but the impact on the local markets would be minimal.

Construction and operation workers at Hanford would generate 1,920 and 5,900 additional vehicle trips per day on local roads, respectively. The level of service would not change due to the additional traffic generated during construction. Operations would cause a drop in level of service from B to C on Washington State Route 240 from Washington State Route 24 to Washington State Route 224.

Idaho National Engineering Laboratory. Plutonium material would continue to be stored at ICPP and ZPPR, and in FMF vaults at ANL-W. No additional workforce would be required for continuation of the storage mission at INEL. However, under the Preferred Alternatives, pit disassembly/conversion and MOX facilities would also be located at INEL. Construction of the two facilities would take place concurrently and continue through 2003. Some in-migration would take place both during construction and operation to fill specialized job requirements. Direct employment during peak construction would reach 660 in 1999 and total 1,330 during the first year of full operation in 2003. Total REA employment would increase by 1,192 during construction and by 5,998 during operations. Unemployment would decrease from 5.4 percent to 4.8 percent during peak construction and fall further to 2.4 percent during operation. The per capita income would increase by less than 0.4 percent during construction and by about 1.4 percent during operations.

In-migration to fulfill direct job requirements for both construction and operations would lead to a population increase of less than 1 percent in the ROI. The additional population would increase demand for community services by less than 1 percent during both construction and operations. A total of approximately 7 new teachers would be needed by 1999, and 29 by 2003. Because the increase in demand would occur over a multiyear period and would be distributed over several school districts, there would be no significant impact on any single district. One additional police officer and no firefighters would be needed during the construction phase to maintain the No Action service levels. During operations, five police officers and four firefighters would be needed. While one additional doctor would be required during construction, two doctors would be needed to maintain the No Action doctor-to-population ratio during full operation. In each case, the increase would be less than 1 percent over the No Action Alternative. Demand for housing would also increase, but, the impact on the local markets would be minimal.

Construction and operation workers at INEL would generate 1,267 and 2,554 additional vehicle trips per day on local roads, respectively. The level of service would not change due to the additional traffic generated during construction. Operations would cause a drop in level of service from D to E on US 20 from US 26/91 at Idaho

Falls to US 26 East. Operations would also cause a drop in level of service from B to C on US 20/26 from US 26 East to Idaho State Route 22/33.

Pantex Plant. Buildings 12-66 and 12-82 would be modified to accommodate the long-term storage of Pantex Pu material and RFETS pit Pu material for the storage Preferred Alternative. Additional workers would be required for construction and operation of the modified storage facilities. The Preferred Alternative would also involve locating pit disassembly/conversion and MOX fabrication facilities at Pantex. Construction of these two facilities would take place concurrently and continue through 2003, when full operations would commence. Because the construction of the disposition facilities would require a larger workforce than would modification of the storage facilities, peak construction impacts would occur in 1999. Peak operation impacts would occur in 2005, when all three facilities would be fully operational. Total direct construction employment during peak construction would reach 660 in 1999, and direct operation employment would reach 1,420 in 2005, when all three facilities would be fully operational. Total REA employment would increase by 1,192 during peak construction and by 6,404 during operations. Unemployment would decrease from 4.8 percent to 4.3 percent during peak construction and fall further to 3.0 percent during operations. The per capita income would increase about 0.3 percent during construction and by 0.5 percent during operations.

In-migration to fulfill direct job requirements for both construction and operations would lead to a population increase of 0.1 percent during construction and about 2 percent during operation. The increase in demand for community services during construction would be minimal. One additional teacher would be needed to maintain the No Action level of service. However, no additional police officers, firefighters, or doctors would be required during the construction phase. During operation, an additional 48 teachers would be required to maintain the No Action student-to-teacher ratio. Because the increased demand would occur over a multiyear period and would be distributed over several school districts, there would be no significant impact on any single district. Seven additional police officers and 10 firefighters would be needed to maintain No Action service levels. In addition, seven more doctors would be needed to maintain the No Action doctor-to-population ratio. These increases would average about 2 percent over the No Action Alternative. Demand for housing would also increase, but, the impact on the local markets would be minimal.

Construction and operation workers at Pantex would generate 1,267 and 2,726 additional vehicle trips per day on local roads, respectively. The level of service would not change due to the additional traffic generated during construction. Operations would cause a drop in level of service from A to B on Farm-to-Market 683 from U.S. 60 to Farm-to-Market 293 and on Farm-to-Market 2373 from I-40 to U.S. 60.

Savannah River Site. Under the Preferred Alternative, the Actinide Packaging and Storage Facility in the F-area would be modified to accommodate the long-term storage of the SRS non-pit Pu material and RFETS non-pit Pu material. The modification activities would employ workers from the current workforce, while operation of the expanded storage facility would require some additional workers. Under this alternative, pit disassembly/ conversion, Pu conversion, MOX fuel fabrication, and the ceramic immobilization facilities would also be located at SRS. Construction of the various facilities would continue until 2013, when all of the facilities would become operational. There would be sufficient available labor in the region to fulfill the construction workforce requirements.

Economic impacts from construction would peak in 2010, during construction of the ceramic immobilization facility. Total REA employment would increase by 1,793 due to construction of the ceramic immobilization facility. However, during this same period, the other three disposition facilities would already be operating and generating an additional 6,936 jobs in the REA.

Peak economic impacts would occur in 2013, when all of the storage and disposition facilities would be fully operational. Total employment in the region would increase by 9,482, and unemployment would decrease to 4.5 percent. Regional per capita income would increase by about 1.6 percent.

Because of the demand for in-migrating workers to fill specialized employment requirements, the ROI population would increase by 0.9 percent. Demand for community services would also increase. To maintain the No Action student-to-teacher ratio, a total of 65 new teachers would have to be added to the ROI school districts, an increase of about 1 percent. Because the increase in demand for teachers would take place over a several years and affect several school districts, there would be minimal impact on any single school district.

The population increase would also result in the need for 18 police officers and 18 firefighters to maintain No Action service levels. In addition, 10 doctors would be required to maintain the No Action doctor-to-population ratio. In each case the increase would be about 1 percent or less. The increase in demand for housing would be too small to affect the market.

Construction and operation workers at SRS would generate 1,920 and 6,150 additional vehicle trips per day on local roads, respectively. Construction would cause a drop in level of service from E to F on South Carolina State Route 19 from U.S. 1/78 at Aiken to U.S. 278. Operations would not significantly impact local roads.

Public and Occupational Health and Safety. Tables 4.6.1–8 through 4.6.1–11 present the potential human health impacts from the radiological and hazardous chemical releases during facility normal operations and potential accidents associated with the combination of storage and disposition Preferred Alternative actions at each of the DOE sites.

Normal Operations. The human health impacts from the radiological and hazardous chemical releases during facility normal operations associated with the storage and disposition Preferred Alternative actions were analyzed at each of the DOE sites. The impact of the Preferred Alternative actions were then combined to obtain the "total impact." Total impact for each receptor/impact parameter is the summation of each facility, action, process, or technology for each of the operational campaigns (the number of years required to complete Pu disposition). Under normal radiological operations, the annual incremental dose to the MEI ranges from 2.7×10^{-4} mrem/yr at INEL to 4.1×10^{-3} mrem/yr at SRS. All doses, when added to No Action, are within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. The annual incremental dose to the population within 80 km (50 mi) from the Preferred Alternative ranges from 4.2×10^{-3} person-rem/yr at INEL to 0.22 person-rem/yr at SRS. For DOE activities, proposed 10 CFR 834 (See 58 FR 1628) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an ALARA Program. When the contribution from the Preferred Alternative is combined with the No Action population dose for each of the sites, the total dose is well within the proposed 10 CFR 834. The dose assessments of the involved worker for storage and disposition facilities are within DOE radiological limits and administrative control levels. The incremental latent cancer fatalities to the involved workforce statistically estimated from these doses attributed to the Preferred Alternative range from 0.48 at INEL to 1.32 at SRS for the entire campaign (estimates based on the *1990 Recommendations of the International Commission of Radiological Protection*).

Facility Accidents. A set of potential accidents was postulated for each component of the Preferred Alternative. For each DOE site subject to multiple storage and disposition actions (Hanford, INEL, Pantex, and SRS), this includes a set of accidents for the storage option coupled with the combination of preferred disposition technologies assumed for the analysis. For the Existing LWR Alternative, a PRA approach was applied to determine the effects of operating an existing LWR with a MOX core. The incremental effects are described below.

One measure of impact calculated from modeled accident scenarios is expected risk, the summation of risk (the product of accident occurrence probability and consequence) for the accident spectrum modeled for each component of the Preferred Alternative. These expected risks were aggregated for the Preferred Alternative for the following impact receptors: 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. Aggregated expected risk estimates of cancer fatality(s) for each assumed campaign under the Preferred Alternative range from: 1.3×10^{-6} at INEL to 1.5×10^{-5} at Pantex; 1.4×10^{-8} at INEL to

Table 4.6.1–9. Potential Human Health Impacts to the Public and Workers Under Normal Operation and Potential Accidents for the Preferred Alternative at Idaho National Engineering Laboratory

Receptor/Impact Parameter	Site No Action/ Reference Baseline (per 50 years of operation)[a,b]	Disposition Facility: Pit Disassembly/ Conversion (per 10-year campaign)[b]	Disposition Facility: MOX Fuel Fabrication (per 11-year campaign)[b]	Total Incremental Impact
Normal Operations				
Radiological Impacts				
MEI				
Annual dose (mrem/yr)	0.018	1.8×10^{-4}	8.8×10^{-5}	2.7×10^{-4}
Health effects (LCF risk)	4.4×10^{-7}	9.0×10^{-10}	4.9×10^{-10}	1.4×10^{-9}
Public Within 80 km				
Annual dose (person-rem/yr)	2.4	3.2×10^{-3}	9.7×10^{-4}	4.2×10^{-3}
Health effects (LCFs)	0.061	1.5×10^{-5}	5.4×10^{-6}	2.0×10^{-5}
Total Involved Workforce				
Health effects (LCFs)	4.4	0.34	0.14	0.48
Hazardous Chemical Impacts				
MEI				
Hazard index	1.5×10^{-2}	5.8×10^{-5}	7.1×10^{-5}	1.3×10^{-4}
Cancer risk	3.6×10^{-6}	0	0	0
Worker Onsite				
Hazard index	2.2×10^{-1}	5.1×10^{-4}	1.6×10^{-3}	2.1×10^{-3}
Cancer risk	7.7×10^{-4}	0	0	0
Facility Accidents				
MEI (LCF risk)	c	6.6×10^{-9}	7.1×10^{-9}	1.4×10^{-8}
Public within 80 km (LCF risk)	c	1.4×10^{-5}	1.6×10^{-5}	3.0×10^{-5}
Worker at 1,000 m (LCF risk)	c	6.1×10^{-7}	6.5×10^{-7}	1.3×10^{-6}

[a] The contribution from existing Pu storage is included in the site No Action total. A more detailed description of No Action impacts can be found in Section 4.2.3.9.

[b] Applies to health effects calculations for normal operations and facility accident risks.

[c] The safety to workers and the public from accidents at existing facilities is controlled by Technical Safety Requirements specified in a SAR or a Basis for Interim Operations document.

Note: LCF=latent cancer fatality; MEI=maximally exposed individual member of the public.

Source: Section 4.2.3.9; Section 4.3.1.9; Section 4.3.2.9; Section 4.3.4.1.9; Section 4.3.5.1.9.

6.0×10^{-6} at Pantex; and 3.0×10^{-5} at INEL to 9.1×10^{-4} at Pantex; respectively for these impact receptors. The Y–12 upgrade at ORR under the Preferred Alternative could reduce the expected risk of cancer fatalities for the design basis accidents analyzed in the Y–12 EA to 5.1×10^{-7}, 7.4×10^{-6}, and 5.7×10^{-8} per year for the 80-km (50-mi) offsite population, MEI, and noninvolved worker, respectively by meeting the performance goal for a moderate hazard facility of Performance Category 3 as prescribed in DOE Order 5480.28, *Natural Phenomena Hazards Mitigation*.

The evaluated accident scenario with the highest risk to the public at the DOE sites under the Preferred Alternative (a fire on the loading dock of the MOX fuel fabrication facility) would result in an estimated risk of 5.2×10^{-5}, 1.6×10^{-5}, 1.8×10^{-5}, and 5.2×10^{-5} cancer fatalities over the assumed MOX fuel fabrication campaign at Hanford, INEL, Pantex, and SRS, respectively.

Table 4.6.1–10. Potential Human Health Impacts to the Public and Workers Under Normal Operation and Potential Accidents for the Preferred Alternative at Pantex Plant

Receptor/Impact Parameter	No Action/ Reference Baseline (per 50 years of operation)[a]	Pantex Pu Storage Upgrade (per 50 years of operation)[a,b]	Disposition Facility: Pit Disassembly/ Conversion (per 10-year campaign)[a]	Disposition Facility: MOX Fuel Fabrication (per 11-year campaign)[a]	Total Incremental Impact
Normal Operations					
Radiological Impacts					
MEI					
Annual dose (mrem/yr)	$6.1x10^{-5}$	$1.8x10^{-8}$	$1.1x10^{-3}$	$5.2x10^{-4}$	$1.6x10^{-3}$
Health effects (LCF risk)	$1.5x10^{-9}$	$4.5x10^{-13}$	$5.5x10^{-9}$	$2.9x10^{-9}$	$8.4x10^{-9}$
Public Within 80 km					
Annual dose (person-rem/yr)	$2.8x10^{-4}$	$6.3x10^{-6}$	$6.4x10^{-3}$	$2.8x10^{-3}$	$9.2x10^{-3}$
Health effects (LCFs)	$7.0x10^{-6}$	$1.6x10^{-7}$	$3.3x10^{-5}$	$1.6x10^{-5}$	$5.0x10^{-5}$
Total Involved Workforce					
Health effects (LCFs)	0.68	0.12	0.34	0.14	0.6
Hazardous Chemical Impacts					
MEI					
Hazard index	$5.7x10^{-3}$	0	$1.5x10^{-4}$	$1.9x10^{-4}$	$3.4x10^{-4}$
Cancer risk	$1.1x10^{-8}$	0	0	0	0
Worker Onsite					
Hazard index	$6.1x10^{-3}$	0	$2.6x10^{-4}$	$8.0x10^{-4}$	$1.0x10^{-3}$
Cancer risk	$4.5x10^{-7}$	0	0	0	0
Facility Accidents					
MEI (LCF risk)	c	$5.8x10^{-6}$	$1.0x10^{-7}$	$1.2x10^{-7}$	$6.0x10^{-6}$
Public within 80 km (LCF risk)	c	$8.8x10^{-4}$	$1.6x10^{-5}$	$1.8x10^{-5}$	$9.1x10^{-4}$
Worker at 1,000 m (LCF risk)	c	$1.4x10^{-5}$	$2.6x10^{-7}$	$2.9x10^{-7}$	$1.5x10^{-5}$

[a] Applies to health effects calculations for normal operations and facility accident risks.
[b] The committed effective dose equivalent for the storage facility is calculated based upon analysis of measured dose.
[c] The safety to workers and the public from accidents at existing facilities is controlled by Technical Safety Requirements specified in a SAR or a Basis for Interim Operations document.
Note: LCF=latent cancer fatality; MEI=maximally exposed individual member of the public.
Source: Section 4.2.4.9; Section 4.3.1.9; Section 4.3.2.9; Section 4.3.4.1.9; Section 4.3.5.1.9.

Under the Preferred Alternative, the use of LWRs is being pursued for the disposition of surplus plutonium through the use of MOX fuel in place of UO_2. An important question is whether the use of MOX fuel changes the safety envelope of UO_2 fueled reactors documented in SARs, PRAs, and NUREG-1150 (*Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants*). Related reactor safety issues are addressed in a recent report by the NAS (*Management and Disposition of Excess Weapons Plutonium Reactor-Related Options*). The report indicates that the potential influences on safety of the use of MOX fuel in LWRs has been extensively studied in the United States in the 1970s (*Final Generic Environmental Impact Statement on the Use of Recycled Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors*, NUREG-0002). These influences have also been extensively studied in Europe, Japan and Russia. Regarding effects of MOX on accident probabilities, the National Academy of Sciences 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 will involve factors not related to fuel composition and hence unaffected by the use of MOX rather than LEU fuel." 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 consequences 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."

The incremental effects of utilizing MOX fuel in a commercial reactor in place of UO_2 were derived from a quantitative analysis of several typical severe accident scenarios for MOX and UO_2 using the MACCS computer code and generic population and meteorology data. The analysis only considers highly unlikely severe accidents where sufficient damage would occur to cause the release of Pu or uranium. The risks of severe accidents were found to be in the range of plus 8 to minus 7 percent, compared to UO_2 fuel, depending on the accident release scenario. The incremental risk of cancer fatalities to a generic offsite population located within 80 km (50 mi) of the severe accident release point would range from -2.0×10^{-4} to 3.0×10^{-5} per year for the accident release scenarios analyzed. Accidents severe enough to cause a release of Pu or uranium include combinations of events that are highly unlikely. Estimates and analyses presented in chapter 4 and summarized in Table 2.5–3 indicate a range of latent cancer fatalities and risk per year from 5.9×10^3/0.15 to 7.3×10^3/0.16. These preliminary results would be reexamined for licensing purposes and subsequent NEPA review. More detailed safety analyses would be performed using both up-to-date calculations of radionuclide inventories for different fuel compositions and irradiation histories, and population-exposure models for sensitivity changes in those inventories resulting from the use of weapons-grade Pu in the fuel.

Natural Phenomena. Under the Preferred Alternative, HEU would continue to be stored at Y–12 at ORR in existing facilities that would be upgraded. The majority of the HEU would be housed in upgraded facilities currently used for HEU storage. The remaining HEU would be stored in facilities that were formerly used for material processing but are currently being modified and converted into storage areas. Modifications to existing buildings would make the facilities suitable for long-term storage and consist primarily of those upgrades required to meet natural phenomena requirements (including earthquakes and tornadoes) as documented in *Natural Phenomena Upgrade of the Downsized/Consolidated Oak Ridge Uranium/Lithium Plant Facilities* (Y/EN-5080, 1994). The Y–12 storage buildings would be upgraded to meet the performance goal for a moderate hazard facility of Performance Category 3 in DOE Order 5480.28, *Natural Phenomena Hazards Mitigation*. In a Performance Category 3 facility, radioactive or toxic materials are present in significant quantities. Design considerations for this category are to limit facility damage so that hazardous materials can be controlled and confined, occupants can be protected, and functions of the facility can continue without interruption. A performance goal for Performance Category 3 is a hazard exceedance frequency of 1.0×10^{-4} per year (DOE Order 5480.28). Meeting this performance goal would reduce the expected risk for the design basis accidents analyzed in the Y–12 EA (for example, Building 9212) by approximately 80 percent, resulting in a latent cancer fatality risk of 5.1×10^{-7} to the MEI and 5.7×10^{-8} to a noninvolved worker, and potential latent cancer fatalities of 7.4×10^{-6} for the 80-km (50-mi) offsite population.

At SRS, F-Canyon facilities could be used for the immobilization of surplus Pu using the can-in-canister variant under the Preferred Alternative. The earthquake accident analysis in the *Environmental Impact Statement, Interim Management of Nuclear Materials* (IMNM EIS) determined that the F-Canyon facilities are structurally sound. Since that time, DOE has prepared a *Supplemental Analysis of Seismic Activity on F-Canyon* (August 1996). Based on the evaluation, an earthquake that could occur about once every 8,000 years could cause a level of structural damage to F-Canyon similar to the level of damage attributed to the earthquake considered in the IMNM EIS. Thus, the capability of F-Canyon to survive an earthquake more severe than that evaluated in the EIS, in combination with the fact that the likelihood of this level of damage was less than assumed in the EIS (1 per 8,000 years compared to 1 per 5,000 years), indicates that F-Canyon is seismically safe, or safer, than indicated in the IMNM EIS.

Waste Management. There is no spent nuclear fuel or HLW associated with construction or operation of Preferred Alternative facilities, but the ceramic immobilization facility would generate as its product output a stabilized ceramic form spiked with Cs radionuclides. (For immobilization using vitrification a stable glass form of Pu and HLW would be generated.) Storage of this immobilized product would be provided until disposal in a geologic repository pursuant to the NWPA. Pursuant to the NWPA, DOE is currently characterizing the Yucca Mountain Site as a potential repository for spent nuclear fuel and HLW. Legislative clarification, or a determination by the NRC that the immobilized Pu should be isolated as HLW, may be required before the material could be placed in Yucca Mountain should DOE and the President recommend, and Congress approve its operation. No radionuclides, which are RCRA wastes, would be used for immobilization so the immobilized product would be consistent with the repository's WAC. Each of the facilities under the Preferred Alternative has as part of its conceptual design waste management facilities that would treat and package all waste generated into forms that would enable staging and/or disposal in accordance with the regulatory requirements of RCRA, and other applicable statutes. Under the Preferred Alternative, the waste management infrastructure of the individual facilities would be integrated into a single waste management infrastructure to include maximum use of existing and planned site waste management facilities. Depending in part on decisions in the 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. The treatment level and potential disposal of TRU and mixed-TRU waste at WIPP will depend on decisions in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase*. 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 hazardous waste LLW and mixed LLW would be treated and disposed of in accordance with current site practice.

Construction and operation of the proposed facilities would affect existing waste management activities at each of the sites analyzed, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes as shown in Table 4.6.1–12. Wastes generated during construction would consist of wastewater and hazardous and solid nonhazardous wastes. Wastewater and solid nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be treated onsite or shipped offsite, to a commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of offsite in a commercial RCRA-permitted disposal facility. No radioactive or hazardous soil contamination is expected to be generated during construction. However, if any were generated, it would be managed in accordance with site practice and all applicable Federal and State regulations.

Hanford Site. Under the Preferred Alternative approximately 78.2 m^3 (20,660 gal) of liquid and 750 m^3 (981 yd^3) of solid TRU waste would require treatment, and packaging to meet the current planning-basis WIPP WAC or an alternate treatment level. An estimated 200 m^3 (262 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the Hanford Tri-Party Agreement to meet the WIPP WAC or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase,* 109 additional truck shipments per year or, if applicable, 54 regular train shipments per year, or 18 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 70.4 m^3 (18,590 gal) of liquid and 2,010 m^3 (2,630 yd^3) of solid LLW would require treatment, processing, and packaging to meet the WAC of the 200-Area LLW Burial Grounds. After treatment and volume reduction, 2,010 m^3 (2,630 yd^3) of solid LLW would require disposal. Assuming a land usage of factor of 3,400 m^3/ha (1,800 yd^3/acre), this would require 0.6 ha/yr (1.5 acres/yr) of LLW disposal area. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.2 m^3 (320 gal) of liquid and 231 m^3 (302 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the Hanford Tri-Party Agreement. The 46 m^3 (12,150 gal) of liquid and 184 m^3 (241 yd^3) of solid hazardous wastes would be collected, treated onsite or offsite, and shipped in Department of

Transportation (DOT)-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of offsite in commercial RCRA-permitted disposal facilities.

Approximately 177,000 m^3 (46.8 million gal) of liquid nonhazardous sanitary and industrial wastewater and 170,000 m^3 (45.0 million gal) of steam plant and cooling blowdown and estimated stormwater runoff would require treatment in accordance with site practice. Depending on actual site location, expansion of existing or construction of new sanitary, utility, and process wastewater treatment facilities may be required. The 3,240 m^3 (4,240 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to the City of Richland landfill per current site practice.

Idaho National Engineering Laboratory. Under the Preferred Alternative approximately 373 m^3 (488 yd^3) of solid TRU waste would require treatment and packaging to meet the current planning-basis WIPP WAC or an alternate treatment level. An estimated 8 m^3 (11 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the INEL Site Treatment Plan to meet the current planning-basis WIPP WAC or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase,* 44 additional truck shipments per year or, if applicable, 22 regular train shipments per year, or 7 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 8 m^3 (2,000 gal) of liquid and 255 m^3 (333 yd^3) of solid LLW would require treatment, processing, and packaging to meet the WAC of the RWMC. Assuming a land usage of factor of 6,200 m^3/ha (3,300 yd^3/acre), the disposal of LLW would require 0.04 ha/yr (0.1 acres/yr) of LLW disposal area. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.1 m^3 (290 gal) of liquid and 40 m^3 (52 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the INEL Site Treatment Plan. The 6 m^3 (1,500 gal) of liquid and 154 m^3 (201 yd^3) of solid hazardous wastes would be collected, treated onsite or offsite, and shipped in DOT-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of offsite in commercial RCRA-permitted disposal facilities.

Approximately 129,000 m^3 (34.0 million gal) of liquid nonhazardous sanitary, industrial, and other process wastewater would require treatment in accordance with site practice. Depending on actual site location, expansion of existing or construction of new sanitary, utility, and process wastewater treatment facilities may be required. The 253 m^3 (331 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to the onsite landfill per current site practice.

Pantex Plant. Under the Preferred Alternative approximately 374 m^3 (489 yd^3) of solid TRU waste would require treatment and packaging to meet the current planning-basis WIPP WAC or an alternate treatment level. An estimated 8 m^3 (11 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the *Pantex Plant Federal Facility Compliance Act Site Treatment Plan/Compliance Plan* to meet the WIPP WAC or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase,* 44 additional truck shipments per year or, if applicable, 22 regular train shipments per year, or 7 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 8 m^3 (2,100 gal) of liquid and 392 m^3 (513 yd^3) of solid LLW would require treatment, processing, and packaging to meet the WAC of the NTS Area 5 RWMS WAC. After treatment and volume reduction, 324 m^3 (424 yd^3) of solid LLW would require disposal. Assuming a land usage of factor of 6,000 m^3/ha (3,200 yd^3/acre), the disposal of LLW would require 0.05 ha/yr (0.13 acres/yr) of LLW disposal area at NTS. Assuming 16.6 m^3 (21.7 yd^3) of LLW per shipment, 20 additional LLW shipments per year from Pantex to NTS would be required. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.3 m^3 (350 gal) of liquid and 48 m^3 (63 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the *Pantex Plant Federal Facility Compliance Act Site Treatment Plan/Compliance Plan*. The 7 m^3 (1,760 gal) of liquid and 155 m^3 (203 yd^3) of solid hazardous wastes would be collected, treated onsite or offsite, and shipped in DOT-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of offsite in commercial RCRA-permitted disposal facilities.

Approximately 141,000 m^3 (37.2 million gal) of liquid nonhazardous sanitary, industrial, and other process wastewater would require treatment in accordance with site practice. Depending on site location, expansion of existing or construction of new utility and process wastewater treatment facilities may be required. The existing sanitary wastewater treatment system has adequate excess capacity to treat the additional quantity of sanitary wastewater. The 391 m^3 (511 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to the City of Amarillo landfill under current site practice.

Savannah River Site. Under the Preferred Alternative approximately 78.2 m^3 (20,660 gal) of liquid and 750 m^3 (981 yd^3) of solid TRU waste would require treatment and packaging to meet the current planning-basis WIPP WAC or an alternate treatment level. An estimated 200 m^3 (262 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the SRS Treatment Plan to meet the current planning-basis WIPP WAC or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase,* 109 additional truck shipments per year or, if applicable, 54 regular train shipments per year, or 18 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 70.4 m^3 (18,600 gal) of liquid and 2,010 m^3 (2,630 yd^3) of solid LLW would require treatment, processing, and packaging to meet the WAC of the SRS E-Area Low-Level Radioactive Disposal Facility. After treatment and volume reduction, 2,010 m^3 (2,630 yd^3) of solid LLW would require disposal. Assuming a land usage of factor of 8,600 m^3/ha (4,600 yd^3/acre), this would require 0.2 ha/yr (0.5 acres/yr) of LLW disposal area. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.2 m^3 (311 gal) of liquid and 231 m^3 (302 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the SRS Site Treatment Plan. The 46 m^3 (12,070 gal) of liquid and 184 m^3 (241 yd^3) of solid hazardous wastes would be collected, treated onsite or offsite, and shipped in DOT-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of offsite in commercial RCRA-permitted disposal facilities.

Approximately 179,000 m^3 (47.3 million gal) of liquid nonhazardous sanitary and industrial wastewater and 170,000 m^3 (45 million gal) of steam plant and cooling blowdown and estimated stormwater runoff would require treatment in accordance with site practice. Depending on actual site location, expansion of existing or construction of new utility and process wastewater treatment facilities may be required. The centralized sanitary wastewater treatment system is adequate to treat the sanitary portion. The 3,250 m^3 (4,250 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to an offsite landfill per current site practice.

Intersite Transportation. A summary of the estimated health effects from transportation of radiological materials for the Preferred Alternative actions at Hanford, INEL, Pantex, and SRS if all the applicable Preferred Alternative disposition facilities were located at a single site is shown in Table 4.6.1–13. If the disposition facilities are at multiple sites then the health effects would be larger, as described below. For the storage Preferred Alternative, there would be no additional transportation of Pu to Hanford and INEL and therefore, no potential fatalities at those sites. Pits from RFETS would be transported to Pantex, and non-pit Pu material from RFETS would be transported to SRS. Pits to be transferred would be packaged in FL (Type B) containers at RFETS before shipment and, upon receipt at Pantex, would be repackaged into AL-R8 containers in Zone 12 South and placed into storage in Zone 4 West pending availability of AT-400A containers and relocation to

Table 4.6.1–13. ***Total Potential Fatalities[a] From the Transportation of Materials for the Preferred Alternative***

Activity	Hanford	INEL	Pantex	SRS
Storage	0.0	0.0	0.006	0.060
Pit disassembly/conversion	0.209	0.161	0.0	0.184
Pu conversion	b	NA	NA	b
MOX fuel fabrication	0.193	0.193	0.193	0.193
Ceramic immobilization	0.98	NA	NA	1.43
Total if disposition activities are one site	1.382	0.354	0.199	1.867

[a] Resulting from both radiological and nonradiological risks for the life of the project.
[b] The analysis assumed that the Pu conversion facility would be located at the immobilization site.
Note: NA = not analyzed for the Preferred Alternative.
Source: Table 4.4.3.2-1; Table 4.4.3.3-1; Table 4.4.3.3-3; Table 4.4.3.3-4.

upgraded storage facilities in Zone 12 South. The transportation of pits between Zone 4 and Zone 12 and the repackaging of the pits from AL-R8 to AT-400A containers is analyzed in the Pantex EIS.

For the disposition alternative, the transportation analysis was based upon the assumption that the storage Preferred Alternative had been implemented prior to the start disposition transportation.

Further, the reactor portion of the disposition Preferred Alternative assumed that the pit disassembly/conversion facility and the MOX facility could be sited at one location or sited at different locations. The total potential fatalities could range from 0.193 (the pit disassembly/conversion and MOX facilities at Pantex) to 0.761 (the pit disassembly/conversion and MOX facilities at different sites). In addition to the DOE sites, there would be transportation of the MOX fuel from the DOE site to existing reactors. The destination of the MOX fuel could be either the eastern or western United States. Assuming 4,000 km (2,484 mi), there would be an additional 3.61 potential fatalities.

For the immobilization portion of the disposition Preferred Alternative, the analysis assumed that the Pu conversion and ceramic immobilization facility would be at the same location. The total potential fatalities could range from 0.98 (both facilities at Hanford) to 1.43 (both facilities at SRS). The analysis includes the effect of transporting Cs-137 to the immobilization site and the transportation of immobilized materials to a HLW repository site. The ceramic immobilization facility was selected for this analysis because the transportation impacts were slightly greater that the vitrification facility.

Environmental Justice. The public health and safety analyses show that air emissions and hazardous chemical and radiological releases from normal operations for all of the storage alternatives would be within regulatory limits and that no latent cancer fatalities would result. Because no populations within 80 km (58 mi) of the proposed site would experience high or adverse health or environmental impacts, neither minority populations nor low-income populations would experience disproportionate high and adverse human health or environmental impacts.

The public health and safety analyses also indicate that radiological releases from accidents would not result in significant adverse human health or environmental impacts. Therefore, such accidents would not have disproportionately high and adverse impacts on minority or low-income populations. Potential transportation accidents would be random events along the transportation corridors, therefore, such accidents would not disproportionately impact minority or low income populations.

4.6.2 LONG-TERM STORAGE ALTERNATIVES

Tables 4.6.2–1 through 4.6.2–6 present the maximum requirements for key environmental resources. The following paragraphs discuss the unique impacts related to each alternative evaluated.

Table 4.6.2–1. Maximum Incremental Direct Employment Over No Action Generated During Operation at Each Candidate Site

Site	Total Site Employment in 2005	Upgrade	Consolidation	Collocation
Hanford	14,586	252[a]	443	572
NTS	3,800	NA	527[b]	641[b]
INEL	6,911	116[a]	432	561
Pantex	3,559	90[c]	509[b]	601
ORR	18,010	111	[d]	566[e]
SRS	16,562	30[f]	485	614

[a] Upgrade with RFETS and LANL material.
[b] Construct new and modify existing facilities.
[c] Upgrade with RFETS and LANL materials. Actual number of employees during operation could be higher.
[d] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[e] Construct new Pu and HEU facilities.
[f] Workers would be supplied from existing workforce.
Note: NA=not applicable.

Table 4.6.2–2. Maximum Annual Net Incremental Water Usage Over No Action During Operation at Each Candidate Site

Site	Water Usage in 2005 (MLY)	Upgrade (MLY)	Consolidation (MLY)	Collocation (MLY)
Hanford	195	8.9[a]	110	150
NTS	2,400	NA	130[b]	190[b]
INEL	7,570	22[a]	66	87
Pantex	249	110[a]	110[c]	130
ORR	14,760	0.24	[d]	360[e]
SRS	13,247	7.1[a]	360	460

[a] Upgrade with RFETS and LANL material.
[b] Modify P-Tunnel.
[c] Construct new and modify existing facilities.
[d] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[e] Construct new Pu and HEU facilities.
Note: NA=not applicable.

Table 4.6.2–3. Maximum Annual Net Incremental Volume of Solid Low-Level Waste Generated Over No Action During Operation at Each Candidate Site

Site	Water Generation in 2005 (m^3)	Upgrade (m^3)	Consolidation (m^3)	Collocation (m^3)
Hanford	3,390	89[a]	1,260	1,300
NTS	15,000	NA	1,260	1,300
INEL	7,200	500[a]	1,260	1,300
Pantex	32	1,260[a]	1,260	1,300
ORR	7,320	3	[b]	1,300[c]
SRS	16,400	0[a]	1,220[d]	1,260[d]

[a] Upgrade with RFETS and LANL material.
[b] Since HEU is currently at ORR, the Consolidation and Collocation Alternatives would be the same.
[c] Construct new Pu and HEU facilities.
[d] Net waste from new facility and from phaseout of existing facility.
Note: NA=not applicable.

Table 4.6.2–4. Maximum Annual Net Incremental Volume of Solid Transuranic Waste Generated Over No Action During Operation at Each Candidate Site

Site	Water Generation in 2005 (m^3)	Upgrade (m^3)	Consolidation (m^3)	Collocation (m^3)
Hanford	271	21[a]	10	10
NTS	0	NA	10	10
INEL	3.5	2[a]	10	10
Pantex	0	10[a]	10	10
ORR	119	0	[b]	10
SRS	338	0	2[c]	2[c]

[a] Upgrade with RFETS and LANL material.
[b] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[c] Net waste from new facility and phaseout of existing facility.
Note: NA=not applicable.

Table 4.6.2–5. Maximum Annual Net Incremental Volume of Solid Hazardous Waste Generated Over No Action During Operation at Each Candidate Site

Site	Water Generation in 2005 (m^3)	Upgrade (m^3)	Consolidation (m^3)	Collocation (m^3)
Hanford	560	4	2	2
NTS	212	NA	2	2
INEL	1,200	1	2	2
Pantex	31	2[a]	2	2
ORR	26	0.8[b]	[c]	2
SRS	15,100	0.8[a]	2	2

[a] Upgrade with RFETS and LANL material.
[b] Solid hazardous material includes mixed low-level waste at ORR.
[c] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
Note: NA=not applicable.

Table 4.6.2–6. Maximum Latent Cancer Fatalities Over No Action for Maximally Exposed Individual for 50 Years From Normal Operation

Site	Risk of Fatal Cancer in 2005	Upgrade	Consolidation	Collocation
Hanford	$1.0x10^{-8}$	$4.5x10^{-11}$	$6.2x10^{-11}$	$6.2x10^{-11}$
NTS	$1.0x10^{-7}$	NA	$1.4x10^{-10}$	$1.4x10^{-10}$
INEL	$4.4x10^{-7}$	$1.3x10^{-11}$	$4.0x10^{-11}$	$4.0x10^{-11}$
Pantex	$1.5x10^{-9}$	$4.5x10^{-13}$	$2.4x10^{-10}$	$2.4x10^{-10}$
ORR	$3.5x10^{-8}$	$5.5x10^{-13}$	[a]	$1.1x10^{-9}$
SRS	$2.0x10^{-5}$	$2.1x10^{-10}$	$3.5x10^{-10}$	$3.5x10^{-10}$

[a] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
Note: NA=not applicable.

4.6.2.1 *No Action*

The No Action Alternative, which would continue existing storage practices, would have no or negligible impacts to land resources at all of the DOE sites under consideration. Land use would conform with existing land-use plans, policies, and controls, and the landscape character would remain compatible. The No Action Alternative would not affect site infrastructure and waste management facilities beyond the normal, scheduled maintenance, repair, and upgrades. Most of the DOE sites under consideration are operating at or below their respective site infrastructure and waste management capacities.

Air emissions from continuing operations would continue to affect local air quality, but the sites are expected to continue to comply with the ambient air quality standards and guidelines. Noise emissions from ongoing operations are consistent with the land-use categories and do not violate any existing local government noise standards. Geology and soils are not being affected by ongoing operations.

Biological resources and cultural and paleontological resources would experience no or negligible impacts from the No Action Alternative. Most industrial areas of the DOE sites have already been heavily disturbed, so existing storage practices are not causing any further disturbance of cultural and paleontological resources or terrestrial plant communities. Any wildlife still inhabiting the area, including any threatened and endangered or other special status species, have adjusted to the existing environment, and continuing operations are unlikely to have any additional impacts. Under the No Action Alternative, surplus fissile materials would stay in place, so there would be no impact from intersite transportation. Due to ongoing changes in workforce size, the No Action Alternative could continue to generate employment impacts to the local communities surrounding the DOE sites under consideration.

[Text deleted.]

Impacts to water resources at Pantex result from the continued local drawdown of the Ogallala Aquifer, one of the largest aquifers in the western United States. By 2005, changes in activities and improvements in operation that will reduce Pantex's contribution to this drawdown are expected to decrease drawdown by approximately 70 percent from current levels. Neither surface nor groundwater resources at the other DOE sites would be affected.

4.6.2.2 **Upgrade**

The Upgrade Alternative does not apply to NTS, RFETS or LANL. The implementation of the Upgrade Alternative would have no or negligible additional impacts to land resources, biological resources, and waste management at any of the remaining DOE sites under consideration. [Text deleted.]

The Upgrade Alternative would have the potential for additional impacts to air quality at Hanford (both options), INEL, Pantex, and SRS, because air pollutant concentrations would increase during construction and operations. Projected emissions would be lower at ORR. At all sites, projected emissions for both criteria and hazardous pollutants would not exceed, and would comply with ambient air quality standards and NESHAPS during both construction and operations. Cultural and paleontological resources at candidate DOE sites could be affected wherever there is ground disturbance due to construction activities, except at Hanford under the modification of existing facilities option, and at Pantex, where construction would be within an area that was previously disturbed. Operation of facilities may have some effect on Native American resources at Hanford, INEL, and SRS. Soil resources would be affected at DOE sites under consideration wherever ground disturbance due to construction activities occurs. Implementation of the Upgrade Alternative would have no or negligible impacts to geologic resources.

[Text deleted.]

Because of the continued depletion of the Ogallala Aquifer, water resources would be affected at Pantex. Either Upgrade Alternative (with or without RFETS and LANL material) would require additional water for construction and operation. However, this additional use, factored in with the projected decrease under No Action, would result in an overall decrease in water use at Pantex. Surface and groundwater resources at the other DOE sites would be adequate to meet the additional water requirements for this alternative.

4.6.2.3 Consolidation

Under this alternative, there could be a temporary decrease in level of service on one or more local roads at INEL during construction. [Text deleted.] Air quality could potentially be affected at all DOE sites by construction and operations activities that would increase emissions, especially PM_{10} and TSP. The sites are expected to comply with ambient air quality standards and guidelines. At all of the DOE sites under consideration, cultural and paleontological resources could be affected wherever there is ground disturbance due to construction activities. Additionally, some Native American resources may be affected by facility operations at Hanford, NTS, INEL, Pantex, and SRS.

[Text deleted.]

The Consolidation Alternative would generate potential impacts on the following: land use at NTS under the P-Tunnel modification option; soil resources at all DOE sites considered; water resources at Pantex (both options); biological resources at Hanford, NTS under the new facility construction option, INEL, Pantex (both options), and SRS; and waste management at all sites. Land resources at NTS under the P-Tunnel modification option could have impacts on weapons effects testing ability. [Text deleted.]

At all of the DOE sites under consideration, soil resources would be affected by ground disturbance associated with construction activities. Because of the continued depletion of the Ogallala Aquifer, water resources would be affected at Pantex. This alternative would require an additional 110 million l/yr (29.1 million gal/yr). However, this additional use, factored in with the projected decrease under No Action, would result in an overall decrease in water use of 57 percent by 2005. Surface and groundwater resources at the other DOE sites would not be affected by this alternative.

With the exception of NTS (under the P-Tunnel modification option) and Pantex, where no or negligible impacts would occur, biological resources would experience impacts under the Consolidation Alternative at all of the DOE sites. There would be habitat loss, and some reptiles and small mammals would not be expected to survive the ground disturbance associated with construction activities. In addition, the potential exists for impacts to either federally or State-listed threatened and endangered or special status species at Hanford, NTS (under the new facility construction option), INEL, and SRS. There could be impacts to playa wetlands at Pantex (both options). Impacts to waste management would occur at NTS (both options) and INEL where construction of utility and process wastewater treatment systems for nonhazardous liquid wastes would be required. In addition, NTS would require new sanitary lagoons.

4.6.2.4 Collocation

Under the Collocation Alternative, the level of service on one or more local roads would increase during construction at INEL, Pantex, and ORR (all three options). [Text deleted.] The potential for impacts to air quality would occur at all of the DOE sites due to increased levels of PM_{10} and TSP emissions from construction and operation activities. The sites are expected to comply with ambient air quality standards and guidelines. Cultural and paleontological resources at all candidate sites could potentially be affected wherever there is ground disturbance due to construction activities at all of the DOE sites under consideration. Operation could potentially affect Native American resources at all sites.

[Text deleted.]

The Collocation Alternative would cause impacts to the following: land resources at NTS (under the P-Tunnel modification option) and ORR (all three options); soil resources at all DOE sites; water resources at Pantex; biological resources at all DOE sites except Pantex; and waste management at Hanford, NTS (both options), and INEL. Land use at NTS under the P-Tunnel modification option could have impacts on weapons effects testing ability. [Text deleted.] At ORR, construction and operation of the proposed sites for all three options could result in visual impacts to Bear Creek Road and Route 95 sensitive viewpoints and could cause the VRM classifications to change from Class 4 to Class 5.

At all of the DOE sites under consideration, soil resources would be affected by ground disturbance associated with construction activities. Because of the continued depletion of the Ogallala Aquifer, water resources would be affected at Pantex. This alternative would require an additional 130 million l/yr (34.3 million gal/yr). However, this additional use, factored in with the projected decrease under No Action, would result in an overall decrease in water use of 55 percent by 2005. Surface and groundwater resources at the other DOE sites would not be affected by this alternative.

With the exception of NTS (under the P-Tunnel modification option) and Pantex, where no or negligible impacts would occur, biological resources at all of the DOE sites would experience impacts under the Collocation Alternative. There would be habitat loss, and some reptiles and small mammals would not be expected to survive the ground disturbance associated with construction activities. In addition, the potential exists for impacts to either federally or State-listed threatened and endangered or special status species at, Hanford, NTS (under the new facility construction option), INEL, ORR, and SRS. There could be impacts to wetlands and aquatic resources at Pantex and ORR (all three options) from sediment runoff during construction.

Implementation of this alternative would require construction of sanitary, utility, and process wastewater treatment systems to treat nonhazardous liquid wastes at Hanford and at NTS under the new facility construction option. Under the P-Tunnel modification option at NTS, expansion of the Area 12 sanitary wastewater treatment facility would be required to treat liquid nonhazardous waste. Construction of utility and process wastewater treatment systems to treat nonhazardous liquid wastes would be required at INEL.

4.6.2.5 Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

If the strategic reserve and weapons R&D materials are not included, the incremental impacts would remain the same for some resources because the building would be approximately the same (for example, land, geology, cultural). For other resources the change would be minimal because there would be a slight decrease if the strategic reserve is not included (for example, radiological releases to the public). Other impacts are proportional to the amount of material being stored.

4.6.2.6 Phaseout

For both the Consolidation and Collocation Alternatives, storage of existing Pu and HEU materials at various sites would be phased out. In addition, storage of existing Pu and HEU materials would be phased out at LANL and RFETS as a result of some of the Upgrade Alternatives. Phaseout would have no or negligible impacts for all environmental resource and issue areas except cultural resources at all DOE sites other than Pantex, and public and occupational health and safety at all DOE sites. The impacts of intersite transportation are addressed under the Consolidation and Collocation Alternatives. For all DOE sites, with the exception of Pantex, phaseout could potentially affect cultural resources if any of the structures eligible for NRHP listing are modified or are not maintained. Currently, none of the affected structures in Zone 4 at Pantex are considered eligible for NRHP listing. All of the regional economic areas surrounding the affected DOE sites would experience a loss in employment with phaseout. However, compared to the total employment in these areas, the loss of jobs would be small and would have no or negligible impacts.

[Text deleted.] Phaseout of existing Pu storage facilities would reduce the impacts from radiological and chemical releases and exposures to levels slightly below the No Action levels for normal operations. All workers involved in the transfer of the Pu would be monitored to ensure that their doses remain within acceptable levels. However, the radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. However, there would be a potential for accidents during the phaseout process from Pu handling, packaging, and transportation that could affect workers and the public. These potential accidents and their consequences have been included in the intersite transportation analysis. As mentioned in the No Action Alternative, only under unusual wind conditions at SRS would low income and minority populations have the potential to be disproportionately affected by an accidental release. Potential intersite transportation impacts related to all DOE sites could occur because of the increased risk of traffic accident fatalities.

For air quality, there could be some short-term impacts resulting from handling and shipping operations, but overall, the elimination of storage alternatives is not expected to result in any long-term impacts.

[Text deleted.]

4.6.3 DISPOSITION ALTERNATIVES

[Text deleted.]

Table 4.6.3–1 represents the incremental impacts to key environmental resources for the activities common to disposition alternatives. Table 4.6.3–2 represents the incremental impacts to the same resources for each individual disposition alternative.

4.6.2.5 Subalternative Not Including Strategic Reserve and Weapons Research and Development Materials

If the strategic reserve and weapons R&D materials are not included, the incremental impacts would remain the same for some resources because the building would be approximately the same (for example, land, geology, cultural). For other resources the change would be minimal because there would be a slight decrease if the strategic reserve is not included (for example, radiological releases to the public). Other impacts are proportional to the amount of material being stored.

4.6.2.6 Phaseout

For both the Consolidation and Collocation Alternatives, storage of existing Pu and HEU materials at various sites would be phased out. In addition, storage of existing Pu and HEU materials would be phased out at LANL and RFETS as a result of some of the Upgrade Alternatives. Phaseout would have no or negligible impacts for all environmental resource and issue areas except cultural resources at all DOE sites other than Pantex, and public and occupational health and safety at all DOE sites. The impacts of intersite transportation are addressed under the Consolidation and Collocation Alternatives. For all DOE sites, with the exception of Pantex, phaseout could potentially affect cultural resources if any of the structures eligible for NRHP listing are modified or are not maintained. Currently, none of the affected structures in Zone 4 at Pantex are considered eligible for NRHP listing. All of the regional economic areas surrounding the affected DOE sites would experience a loss in employment with phaseout. However, compared to the total employment in these areas, the loss of jobs would be small and would have no or negligible impacts.

[Text deleted.] Phaseout of existing Pu storage facilities would reduce the impacts from radiological and chemical releases and exposures to levels slightly below the No Action levels for normal operations. All workers involved in the transfer of the Pu would be monitored to ensure that their doses remain within acceptable levels. However, the radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. However, there would be a potential for accidents during the phaseout process from Pu handling, packaging, and transportation that could affect workers and the public. These potential accidents and their consequences have been included in the intersite transportation analysis. As mentioned in the No Action Alternative, only under unusual wind conditions at SRS would low income and minority populations have the potential to be disproportionately affected by an accidental release. Potential intersite transportation impacts related to all DOE sites could occur because of the increased risk of traffic accident fatalities.

For air quality, there could be some short-term impacts resulting from handling and shipping operations, but overall, the elimination of storage alternatives is not expected to result in any long-term impacts.

[Text deleted.]

4.6.3 Disposition Alternatives

[Text deleted.]

Table 4.6.3–1 represents the incremental impacts to key environmental resources for the activities common to disposition alternatives. Table 4.6.3–2 represents the incremental impacts to the same resources for each individual disposition alternative.

Table 4.6.3–1. Incremental Net Increase During Operation for Activities Common to Disposition Alternatives

Resource	Pit Disassembly/ Conversion Facility	Pu Conversion Facility	MOX Fuel Fabrication
Land area used (ha)	12	28	81
Water usage (MLY)	94.6	80.5	56.8
Maximum direct employment	830	883	500
Risk of fatal cancer for MEI from lifetime operations	$7.6x10^{-10}$ to $7.0x10^{-8}$	$4.8x10^{-10}$ to $4.6x10^{-8}$	$1.8x10^{-7}$ to $7.8x10^{-10}$
Solid TRU waste (m^3/yr)	67	278	306
Solid LLW (m^3/yr)	102	1,743	153
Solid hazardous waste (m^3/yr)	0.7	11	153
Spent nuclear fuel[a] (t/yr)	0	0	0

[a] Residual heavy metal content.

4.6.3.1 Activities Common to Disposition Alternatives

Implementation of any of the disposition alternatives would require construction and operation of the pit disassembly/conversion facility or the Pu conversion facility, either at the same site or at two different sites. In addition, selection of any of the reactor alternatives would require construction of the MOX fuel fabrication facility, either collocated with the reactor or located at another site.

Pit Disassembly/Conversion Facility

Construction and operation of the pit disassembly facility would have no or negligible impacts to noise and geology at all of the DOE sites analyzed. The associated employment would generate minor socioeconomic benefits at all of the DOE sites.

Impacts to biological resources at each site are possible because of habitat loss associated with land disturbance. There is the potential for impacts to special status species at Hanford, to the desert tortoise at NTS, and playa wetlands at Pantex. At all of the DOE sites except ORR, cultural and paleontological resources could be affected wherever there is ground disturbance, especially in areas that have not been extensively surveyed. Operation may affect Native American resources at all sites except ORR. Waste management impacts could occur at Hanford, INEL, and SRS due to the increase in TRU waste shipments and onsite LLW disposal. A radioactive waste facility would be required at ORR, so potential impacts to waste management at ORR are possible. Impacts to waste management would occur at NTS and Pantex, where the pit disassembly/conversion facility would require construction of a radioactive waste management facility. Potential impacts from the pit disassembly/conversion facility to public and occupational health and safety exist from the radiological and hazardous chemical releases during normal operation. However, the annual radiological dose to onsite workers and the public would be within radiological limits. Similarly, the health risk to the public and onsite workers would be within hazardous chemical regulatory levels. As mentioned in the No Action Alternative discussion, only under unusual wind conditions at SRS would low income and minority populations have the potential to be disproportionately affected by accidental releases. Intersite transportation impacts related to all DOE sites could occur because of the increased risk of traffic accident fatalities.

Soil resources would be affected at all of the DOE sites under consideration due to ground disturbance associated with construction activities from the pit disassembly/conversion facility. Because this alternative would require an additional 946 million l/yr (25 million gal/yr) of water during operation, water resources would be affected at Pantex. Surface water and groundwater resources at the other DOE sites would be affected minimally by this alternative.

Table 4.6.3–2 Incremental Net Increase During Operation by Disposition Alternative[a]

Resource	Direct Disposition	Immobilized Disposition	Vitrification	Ceramic Immobilization	Electrometallurgical Treatment	5 Existing LWRs[b,c]	2 Partially Completed[b] LWRs	4 Evolutionary LWRs[b] (small)	2 Evolutionary LWRs[b] (Large)
Land area used (ha)	57	75.2	12	12	0	81	81	237	138
Water usage (MLY)	165.4	485.4	250	250	0	56.8	138,225	813-109,065	739-121,777
Maximum direct employment	342	1,180	768	860	83	700	1,775	2,500	2,160
Risk of fatal cancer for MEI from lifetime operations	$1.4x10^{-14}$ to $4.7x10^{-13}$	$9.7x10^{-14}$ to $3.6x10^{-12}$	$3.6x10^{-11}$ to $1.3x10^{-9}$	$6.0x10^{-13}$ to $2.1x10^{-11}$	$3.8x10^{-9}$	$1.3x10^{-7}$ to $2.3x10^{-7}$[c]	$1.3x10^{-5}$	$2.1x10^{-7}$ to $2.4x10^{-5}$	$2.9x10^{-7}$ to $4.1x10^{-5}$
Solid TRU waste (m^3/yr)	0.2	151	99	99	6	306	306	306	306
Solid LLW (m^3/yr)	5	29	14	14	55	153	267-1,427	1,233	1,153
Solid hazardous waste (m^3/yr)	17	38	19	19	0.8	153	207	261	207
Spent nuclear fuel (t/yr)[d]	0	0	0	0	0	70	70	70.6	76.5

[a] Does not include activities common to all disposition alternatives (that is, the Pu conversion facility and the pit disassembly/conversion facility).
[b] Includes the MOX fuel fabrication facility and two to four reactors as indicated.
[c] For the existing LWR, the analysis assumes that two LEU reactor cores would be replaced with MOX cores. Between 3 and 5 reactors would be needed if the LEU core was only partially replaced with MOX fuel.
[d] Residual heavy metal content.

Plutonium Conversion Facility

The environmental impacts of constructing and operating the Pu conversion facility would be identical to those previously identified for the pit disassembly/conversion facility with the following exceptions. The employment associated with construction and operation would generate small socioeconomic benefits at all affected sites. At ORR, NTS, and Pantex, the Pu conversion facility would require construction of a radioactive waste management facility. At Pantex, water requirements for this alternative are slightly less than for the pit disassembly/conversion facility. Also, the annual radiological doses to the public would be slightly lower for the conversion facility than for the disassembly/conversion facility. The doses to onsite workers would be higher for the conversion facility, however, all doses to the public and to onsite workers would be within regulatory limits.

4.6.3.2 Deep Borehole Category

There are two deep borehole category alternatives: the Direct Disposition Alternative and the Immobilized Disposition Alternative. Both require drilling deep boreholes, 4 km (2.5 mi) or more in depth, into geologically stable rock below the water table. The borehole facility would be similar for both alternatives. No specific locations have been identified for the deep borehole facilities, therefore, environmental impacts are evaluated for a generic site. However, the public and occupational health and safety impacts include estimates using representative DOE sites for analysis purposes. The types and range of likely impacts have been identified, but site-specific impacts cannot be determined at this time. Requirements for both alternatives would be in addition to those presented for pit disassembly/conversion facility. The annual radiological doses to the public would be slightly lower for the conversion facility than for the disassembly/conversion facility. The doses to onsite workers would be higher for the conversion facility, however, all doses to the public and to onsite would be within regulatory limits.

4.6.3.2.1 *Direct Disposition*

Under the Direct Disposition Alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, packaged, and placed into a deep borehole. The environmental impacts of implementing this alternative would be the sum of impacts described previously for the pit disassembly/conversion facility and the Pu conversion facility, in addition to the impacts described below.

Infrastructure requirements could exceed current capacities. Air emissions, particularly PM_{10} and TSP concentrations, would be expected to increase during the peak construction period. The potential exists for noise impacts from heavy construction equipment and increased traffic. Water resource requirements would increase during construction and operation, possibly affecting existing supplies, and surface water quality could be affected by discharge of wastewater. Geologic resources could be affected by restricted access, and soil disturbance would occur during construction. There would be a potential for biological resource impacts because of the loss of habitat and potential impacts to wetlands, aquatic resources, and special status species. Cultural resources could be affected whenever there is ground disturbance, especially in areas that have not been extensively surveyed. Operations may affect Native American resources. The associated employment would have a socioeconomic impact, and the level of service on local roadways could decline during construction.

Potential impacts from the Direct Disposition Alternative to public and occupational health and safety exist from the radiological and hazardous chemical releases during normal operations. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. Environmental justice impacts are possible if health and safety or environmental impacts disproportionately affect minority and low-income populations. Potential intersite transportation impacts related to the movement of materials to the deep borehole complex could occur primarily from nonradiological impacts (air pollution and highway accidents) as opposed to impacts from radiological releases.

Impacts to waste management would occur. Construction and operation of a deep borehole disposal facility for direct disposition would require the construction of waste management facilities. These would include facilities to treat and store generated TRU, low-level, hazardous, and nonhazardous wastes.

4.6.3.2.2 *Immobilized Disposition*

Under this alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility and the ceramic immobilization facility, packaged, and placed in a deep borehole. The environmental impacts of implementing this alternative are the sum of the impacts previously described for the pit disassembly/conversion facility and the Pu conversion facility, in addition to the impacts described below.

Ceramic Immobilization Facility. Construction of the ceramic immobilization facility would have potential impacts to land resources, site infrastructure, air quality and noise, and geology and soils. The usage of one or more local roadways would increase during construction at INEL, Pantex, and ORR, and could lead to a temporary decrease in the level of service.

Construction and operation of the ceramic immobilization facility would affect land resources at ORR and water resources at Pantex. For land use at ORR, construction and operation of the ceramic immobilization facility would lead to a reduction in visual quality at the Bear Creek Round and Route 95 sensitive viewpoints, resulting in a VRM classification change from Class 4 to Class 5. Because this alternative would require an additional drawdown of 320 million l/yr (84.5 million gal/yr) of water during operation, water resources would be affected at Pantex. Surface and groundwater resources at the other DOE sites would not be affected by this alternative. At NTS, Pantex, and ORR, construction of a radioactive waste management facility would be necessary.

The potential for impacts to biological resources at each site except SRS exists due to habitat loss associated with land disturbance during construction. At Hanford, Pantex, and ORR, there would also be potential impacts to special status species. At NTS, the desert tortoise and other threatened and endangered species could be affected by construction activities. Playa wetlands at Pantex may be affected. At ORR, the potential for wetlands displacement exists due to land disturbance during construction. Aquatic resources at Pantex and SRS could be affected. At any site where there is ground disturbance (all sites under consideration), cultural and paleontological resources could be affected. Operation may have some impact on Native American resources. There would be the potential for impacts to waste management because of an increase in TRU waste shipments for all sites, onsite LLW disposal at Hanford, INEL, ORR, NTS, and SRS, and an increase in the number of LLW shipments from Pantex to NTS. At all of the DOE sites under consideration, soil resources would be affected by ground disturbance associated with construction activities.

Public and occupational health and safety impacts could result from the radiological and hazardous chemical releases during normal operations. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. As mentioned in the No Action Alternative discussion, exposures to minority and low-income populations in an accident would be dependent upon the magnitude of release and wind direction at the time of the accident. Intersite transportation impacts related to all DOE sites could occur primarily from nonradiological impacts (air pollution and highway accidents) as opposed to impacts from radiological releases.

Deep Borehole Complex. The deep borehole facilities required for this alternative would be similar to those for the Direct Disposition Alternative, with minor exceptions in the receiving and storage facilities and an additional pellet-grout mixing facility and process waste management at the emplacing facilities. Thus, the environmental impacts would be similar to those described previously for the Direct Disposition Alternative.

4.6.3.3 Immobilization Category

Under this category, surplus Pu would be immobilized to create a chemically stable form for emplacement in a HLW repository. The radiation level of the immobilized form would meet the Spent Fuel Standard, which would serve as a proliferation deterrent. There are three Immobilization Alternatives: Vitrification, Ceramic Immobilization, and Electrometallurgical Treatment. Requirements for all three would be in addition to those described previously for pit disassembly/conversion and Pu conversion.

4.6.3.3.1 *Vitrification*

Under the Vitrification Alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, packaged, and transported to the vitrification facility. The environmental impacts of implementing this alternative would be the sum of the impacts described previously for the pit disassembly/conversion facility and the Pu conversion facility, in addition to the impacts described below.

Construction and operation of the vitrification facility would impact land resources at ORR and water resources at Pantex. For land resources at ORR, construction and operation of the vitrification facility would lead to a reduction in visual quality at the Bear Creek Road and Route 95 sensitive viewpoints, resulting in a VRM classification change from Class 4 to Class 5. Because this alternative would require an additional drawdown of 250 million l/yr (66 million gal/yr) of water during operation, water resources would be affected at Pantex. Surface water and groundwater resources at other DOE sites would be affected minimally by this alternative.

Air quality impacts could occur at Pantex and SRS because pollutant concentrations would increase. The potential for impacts to biological resources exists at each site, except SRS, due to habitat loss associated with land disturbance during construction. There is also potential for impacts to special status species at Hanford, Pantex, and ORR; the desert tortoise at NTS; playa wetlands at Pantex; and wetlands and aquatic resources at ORR. At any site where there is ground disturbance (all sites under consideration), cultural and paleontological resources may be affected. Operation has the potential to affect Native American resources at all sites. Soil resources would be affected at all of the DOE sites under consideration by ground disturbance associated with construction activities.

Public and occupational health and safety impacts could result from the radiological and hazardous chemical releases during normal operations. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. As mentioned in the No Action Alternative discussion, exposures to minority and low-income populations in an accident is dependent upon the magnitude of release and wind direction at the time of the accident. Potential intersite transportation impacts related to all DOE sites could occur primarily from nonradiological impacts (air pollution and highway accidents) as opposed to impacts from radiological releases.

Waste management impacts could occur at Hanford, INEL, and SRS, because these sites may require expansion of their existing TRU waste management facilities and construction of sanitary, utility, and process wastewater treatment systems. Impacts to waste management would occur at NTS, Pantex, and ORR, because each site would require the construction of a radioactive waste facility. These three sites may also require the construction of sanitary, utility, and process wastewater treatment systems.

4.6.3.3.2 *Ceramic Immobilization*

Under the Ceramic Immobilization Alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, packaged, and transported to the ceramic immobilization facility. The environmental impacts of implementing this alternative would be the sum of the impacts described previously for the pit disassembly/conversion facility and the Pu conversion facility, in addition to the impacts described below.

The environmental impacts of constructing and operating the ceramic immobilization facility would be identical to those identified in the preceding section for the vitrification facility, with the exception of public health and safety at all sites and air quality at Hanford, NTS, and INEL. The annual radiological doses to the public would be smaller whereas the dose to workers would be somewhat higher for the ceramic immobilization facility. Locating the ceramic immobilization facility at these sites could lead to high pollutant concentrations which would affect air quality.

4.6.3.3.3 *Electrometallurgical Treatment*

Under the Electrometallurgical Treatment Alternative, existing facilities at ANL-W at INEL are used as a basis for analysis. Such facilities would be modified to accommodate this added mission. Surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, packaged, and transported to the electrometallurgical treatment facility. The environmental impacts of implementing this alternative would be the sum of the impacts identified previously for the pit disassembly/ conversion facility and the Pu conversion facility, in addition to the impacts described below.

Public and occupational health and safety, waste management, and intersite transportation would be the resources affected. Public and occupational health and safety impacts could result from the radiological and hazardous chemical releases under the Electrometallurgical Treatment Alternative. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. Waste management impacts would result if additional sanitary, utility, and process wastewater treatment systems are required. Potential intersite transportation impacts could occur at all DOE sites primarily from nonradiological impacts (air pollution and highway accidents) as opposed to impacts from radiological releases.

4.6.3.4 Reactor Category

Four disposition alternatives using reactor technologies would convert Pu to spent nuclear fuel by burning it in a reactor in the form of MOX fuel leading to disposition at a U.S. repository or within the Canadian spent fuel program. The four alternatives are existing LWR, partially completed LWR, evolutionary LWR, and CANDU reactor. Under the Reactor Category Alternatives, surplus Pu would be used as MOX fuel in domestic or Canadian reactors. The United States currently does not have a MOX fuel fabrication facility and does not engage in the commercial MOX fuel market, so a facility would have to be developed at a U.S. site. Under the Existing LWR Alternative, limited quantities of MOX fuel could be produced on an interim basis in existing European facilities using U.S. surplus Pu until a domestic facility is constructed.

4.6.3.4.1 *Mixed Oxide Fuel Fabrication Facility*

Each of the reactor alternatives would require the construction of a MOX fuel fabrication facility that may be collocated with the reactor or located at a separate site. The impacts are described below for DOE sites and a generic site.

Construction and operation of the MOX fuel fabrication facility would have no or negligible impacts to noise and geology at any of the DOE sites. There would be no or negligible impacts to these same environmental resources/issue areas at a generic site.

Because of the continued depletion of the Ogallala Aquifer, water resources would be affected at Pantex, where this alternative would require an additional drawdown of 56.8 million l/yr (15 million gal/yr). Surface and groundwater resources at the other DOE sites would be minimally affected by this alternative.

At all DOE sites, except Pantex, terrestrial resource impacts could result from habitat disturbance. Potential impacts to special status species during construction activities may occur at each DOE site. Playa wetlands at Pantex may be affected. At any site where there is ground disturbance (all DOE sites under consideration except ORR), especially in areas that have not be extensively surveyed, cultural and paleontological resources could be affected. Soil resources would be affected at all of the DOE sites under consideration due to ground disturbance associated with construction.

Potential impacts from the MOX fuel fabrication facility to public and occupational health and safety exist from the radiological and hazardous chemical releases during normal operations. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. As mentioned in the No Action Alternative discussion, exposures to minority and low-income populations in an accident would be dependent upon the magnitude of release and wind direction at the time of the accident. Potential intersite transportation impacts related to all DOE sites could occur, primarily from nonradiological impacts (air pollution and highway accidents) as opposed to impacts from radiological releases.

Impacts to these same environmental resources/issue areas could occur at a generic site: land resources, water resources, soil resources, biological resources, cultural resources, public and occupational health and safety, intersite transportation, and environmental justice.

Construction and operation of the MOX fuel fabrication facility would affect waste management at all of the DOE sites and the generic site. A TRU waste management facility would be required as part of the MOX fuel fabrication facility at NTS, Pantex, ORR, and the generic site. TRU waste management facilities at Hanford, INEL, and SRS would require expansion. All sites would require additional storage facilities where TRU waste would be staged until it is shipped.

4.6.3.4.2 *Existing Light Water Reactor*

Under the Existing LWR Alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, and processed by the MOX fuel fabrication facility. The finished MOX fuel would be transported to three to five LWRs for use instead of conventional uranium reactor fuel. The environmental impacts of implementing this alternative would be the sum of the impacts previously described for the pit disassembly/conversion facility and the Pu conversion facility, the impacts of the MOX fuel fabrication facility, and the reactor impacts described below. The impacts described are for a single reactor. The Pu disposition action would require a minimum of three to five existing LWRs.

The use of an existing LWR would require the substitution of MOX fuel for LEU fuel. There would be no or negligible impacts for all environmental resources/issue areas except public and occupational radiological health and safety, waste management, and intersite transportation. Public and occupational health and safety impacts could result from the radiological releases during normal operations that would be due to the change in doses received when a uranium core is replaced with a MOX core. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The potential for impacts exist for waste management, because an expansion of spent nuclear fuel storage at the site may be required. Intersite transportation impacts related to the transportation of MOX fuel could occur, primarily from nonradiological impacts (air pollution and highway accidents) as opposed to radiological releases.

4.6.3.4.3 *Partially Completed Light Water Reactor*

Under the Partially Completed LWR Alternative, commercial LWRs on which construction has been halted would be completed to burn MOX fuel. The facility and operating characteristics of these units would be essentially the same as for the existing commercial LWRs discussed above. Because no specific site has been identified, impacts are analyzed for a representative site.

Under this alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, followed by the MOX fuel fabrication facility, and the finished MOX fuel transported to the completed LWRs for use instead of conventional LEU reactor fuel. The environmental impacts of implementing this alternative would be the sum of the impacts described previously for the pit disassembly/conversion facility and the Pu conversion facility, the impacts of the MOX fuel fabrication facility, and the impacts described below. The impacts described are for a single reactor. Since the Pu disposition action would require two partially completed LWRs, the requirements would be two times those identified if they are all at one site, or repeated at a second site if two separate geographical locations are chosen.

There would be potential impacts to biological resources, cultural and paleontological resources, soil resources, public and occupational health and safety, waste management, and intersite transportation. Local roads may experience an increase in usage during construction, leading to potential impacts to local transportation.

If ground disturbance is necessary for the completion of construction, both biological and cultural and paleontological resources may be affected. Operation may affect some Native American resources. Impacts to wetlands, aquatic resources, and threatened and endangered species may occur due to facility operations. Soil resources would be affected if ground disturbance is necessary for the completion of construction. Public and occupational health and safety impacts could result from the radiological and hazardous chemical releases under the Partially Completed LWR Alternative. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. Intersite transportation impacts related to the transportation of MOX fuel could occur because of the increased risk of traffic accident fatalities. Impacts to waste management could occur because of the introduction of spent nuclear fuel, LLW, and mixed LLW.

4.6.3.4.4 *Evolutionary Light Water Reactor*

Under the Evolutionary LWR Alternative, the individual reactors would be improved versions of existing commercial nuclear power reactors using light water as a moderator and coolant. The fuel rods would consist of MOX fuel. There could be two design approaches: a large evolutionary LWR and a small evolutionary LWR.

Under this alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or the Pu conversion facility, and processed through the MOX fuel fabrication facility. The finished MOX fuel would be transported to the evolutionary LWRs for use instead of conventional LEU reactor fuel. Therefore, the environmental impacts of implementing this alternative would be the sum of the impacts described previously for the pit disassembly/conversion facility and the Pu conversion facility, the impacts of the MOX fuel fabrication facility, and the impacts described below.

The summary of impacts presented below is based on the conclusions reached for the construction and operation of either a large or small evolutionary LWR. However, the proposed Pu disposition action would require a minimum of two large evolutionary LWRs or four small evolutionary LWRs. Thus, the requirements of implementing this alternative would nominally be two to four times those described if the reactors were built at one site, or would be repeated at more than one site if the reactors were built at multiple locations. Since the Storage and Disposition PEIS is not intended to support a siting decision for the disposition alternatives, the precise configuration is unknown at this time.

Construction and operation of the evolutionary LWR could have site impacts on infrastructure, noise, and geology. With respect to air quality, any increase in pollutant concentrations would not exceed applicable standards. Local roads may experience a decline in the level of service during construction at INEL, Pantex, and ORR.

The potential exists for impacts to biological resources, soil resources, cultural and paleontological resources, and public and occupational health and safety at all DOE sites; waste management at Hanford and INEL; and intersite transportation. Habitat loss during construction could impact wildlife, including special status species, at all sites. At NTS, the desert tortoise could be affected during construction. At Hanford, ORR, and SRS, the potential exists for impacts to sensitive plants from the salt drift from wet cooling towers and to aquatic resources from blowdown waters from the cooling systems into local streams and rivers. Wetlands at Pantex, ORR, and SRS may also be affected. At sites where there is ground disturbance (all sites under consideration), cultural and paleontological resources could be affected. Native American resources may be affected by facility operation. At all of the DOE sites under consideration, soil resources would be affected by ground disturbance associated with construction activities. Hanford and INEL require either major upgrades to existing sanitary, utility, and process wastewater treatment systems or construction of new facilities.

Public and occupational health and safety impacts could result from the radiological and hazardous chemical releases during normal operations at all DOE sites. However, the annual radiological dose to onsite workers and the public would be within radiological limits. The health risk to the public and onsite workers would be within hazardous chemical regulatory levels. Intersite transportation impacts related to all DOE sites could occur, primarily from nonradiological impacts (air pollution and highway accidents) as opposed to radiological releases.

Construction and operation of the evolutionary LWR would have impacts on land resources at ORR; water resources at Pantex; public health and safety at SRS; and waste management at NTS, Pantex, ORR, and SRS. Land resources at ORR would be affected because the proposed use of vacant land would change the VRM classification from Class 3 to Class 5, resulting in visual impacts to the Watts Bar Lake and adjacent area's sensitive viewpoints; and the proposed facility location would not be within the ORR site boundary, but rather on the adjacent TVA land. Because of the continued depletion of the Ogallala Aquifer, water resources would be affected at Pantex, where this alternative would require an additional drawdown of 341 million l/yr (90 million gal/yr). However, this additional use, factored in with the projected decrease under No Action, would result in an overall decrease in water use of 30 percent by 2005. Surface and groundwater resources at the other DOE sites would be minimally affected by this alternative.

At SRS, the radiological dose to the population living within 80 km (50 mi) of the site under normal operations is estimated at 110 person-rem per year and represents 0.049 percent of natural background exposure. As mentioned in the No Action Alternative discussion, exposures to minority and low-income populations surrounding SRS in an accident is dependent upon the magnitude of release and wind direction at the time of the accident.

For waste management, all sites would require the construction of storage facilities for spent nuclear fuel, and both ORR and SRS would require the construction of sanitary, utility, and process wastewater treatment systems. In addition, Pantex would require LLW facilities or additional LLW shipments, and major upgrades or new construction of sanitary, utility, and process wastewater treatment systems.

4.6.3.4.5 *Canadian Deuterium Uranium Reactor*

Under the CANDU Reactor Alternative, surplus Pu would be removed from storage, processed through the pit disassembly/conversion facility or Pu conversion facility, and processed through the MOX fuel fabrication facility. The finished fuel would be transported to the Ontario Hydro Nuclear Bruce-A Generating Station in Ontario, Canada.

Other than intersite transportation impacts, the environmental impacts within the United States of implementing this alternative would be limited to the sum of the impacts described above for the pit disassembly/conversion, Pu conversion facility, and the MOX fuel fabrication facility. Potential intersite transportation impacts related to the transportation of MOX fuel could occur because of the increased risk of traffic accident fatalities. All other impacts would occur in Canada.

[Text deleted.]

4.7 CUMULATIVE IMPACTS

4.7.1 METHODOLOGY

This section identifies the potential for cumulative impacts over the life of the program which could result from incremental impacts of proposed actions and alternatives identified previously, when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such actions.

The reference condition for cumulative effects is the No Action Alternative, which addresses the impacts of past, present, and ongoing programs. In particular, for alternatives that are proposed for DOE sites, the analysis focuses primarily on the potential for cumulative impacts at each candidate site where other programs or environmental management programs are reasonably anticipated.

The reasonably foreseeable future actions that may be implemented at some of the DOE sites under consideration in this PEIS include the following:

- *Storage and Disposition of Weapons-Usable Fissile Materials PEIS* (Final)
- *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* (ROD issued)
- *Disposition of Surplus Highly Enriched Uranium Final EIS* (ROD issued)
- *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Restoration and Waste Management Programs Final Environmental Impact Statement* (ROD issued)
- *Stockpile Stewardship and Management PEIS* (Final)
- *Tritium Supply and Recycling PEIS* (ROD issued)
- *Waste Management PEIS* (Draft)

The following documents and associated actions were considered in assessing cumulative impacts, but were eliminated from further study because they do not contribute to cumulative impacts, they had impacts that were already included in the No Action Alternative, or they would be completed by the 2005 start date:

- *Defense Waste Processing Facility at the Savannah River Site EIS* (ROD issued)
- *Dual Axis Radiographic Hydrodynamic Test Facility EIS* (ROD issued)
- *Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y–12 Plant, Oak Ridge, Tennessee* (FONSI issued)
- *Interim Management of Nuclear Materials at the Savannah River Site EIS* (Final)
- *Plutonium Finishing Plant EIS* (ROD issued)
- *Proposed Medical Isotope Production EIS* (ROD issued)
- *Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (Final)

- *Savannah River Site Waste Management EIS* (ROD issued)
- *EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (Final)
- *Stabilization of Plutonium Solutions Stored in the F-Canyon Facility at the Savannah River Site EIS* (ROD issued)

No other Federal, State, local, or private reasonably foreseeable actions were found that would contribute to cumulative impacts. When possible, planned projects before the 2005 No Action baseline have been incorporated into the No Action Alternative. The No Action Alternative takes into account existing site operations and includes the impacts resulting from planned changes to operations until the year 2005. Projects planned for beyond the 2005 No Action baseline are in such a preliminary stage as to make analysis speculative. Future tiered-NEPA documents would further analyze the impacts from other Federal, State, local, and private actions.

For the Storage Alternatives, the seven DOE programs and the eight DOE sites potentially affected are identified in Table 4.7.1–1. The cumulative impacts for long-term storage are discussed in Section 4.7.2. For the Disposition Alternatives, a generic analysis that is applicable to all DOE sites was developed. Since there are multiple combinations of alternatives that could be selected for the disposition program, a representative scenario was selected for the cumulative impacts analysis. The cumulative impacts for the disposition program are discussed in Section 4.7.3.

Table 4.7.1–1. Reasonably Foreseeable Future Programs at Department of Energy Sites

Program	NEPA Document Status	Hanford	NTS	INEL	Pantex	ORR	SRS	RFETS	LANL
Storage and Disposition	Final PEIS	X	X	X	X	X	X	X	X
Foreign Research Reactor Spent Nuclear Fuel	ROD issued			X			X		
HEU Disposition	ROD issued					X	X		
[Text deleted.]									
Spent Nuclear Fuel	ROD issued	X		X			X		
Stockpile Stewardship and Management	Final PEIS		X		X	X	X		X
Tritium Supply/Recycling	ROD issued						X		
Waste Management	Draft PEIS	X	X	X	X	X	X	X	X

4.7.2 STORAGE ALTERNATIVE CUMULATIVE IMPACTS

4.7.2.1 Hanford Site

4.7.2.1.1 *Land Resources*

In addition to the storage alternatives, Hanford is being considered as a site for the two other DOE programs identified in Table 4.7.1–1. The total area of undisturbed land that could be affected by these programs during operation is 230 ha (570 acres), or less than 0.2 percent of the total land at Hanford. Site development would be performed in accordance with the land use plans in the *Hanford Site Development Plan*. Proposed development would also be compatible with the industrial use visual character of the developed areas of Hanford. Cumulatively, the actions would consume land, but would be consistent with the land-use plans and visual character of the site.

4.7.2.1.2 *Site Infrastructure*

Some cumulative impacts are possible at Hanford resulting from implementation of any of the storage actions when added to the other two DOE programs identified in Table 4.7.1–1. The site infrastructure cumulative impacts at Hanford that would result from operation of the proposed projects are shown in Table 4.7.2.1.2–1. Hanford has adequate site availability to meet the resource requirements for all of the site infrastructure resources.

Table 4.7.2.1.2–1. Site Infrastructure Cumulative Operation Impacts at Hanford Site

	Electrical		Fuel	
Requirement	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)
No Action	345,500	58	9,334,800	21,039,531
Storage and Disposition[a]	92,000	18	38,000	0
Spent Nuclear Fuel	0	NA	0	0
Waste Management	NA	47	NA	NA
Cumulative Requirement	437,500	123	9,372,800	21,039,531
Site Availability	1,678,700	281	14,775,000	21,039,531

[a] Collocation Alternative.

Note: NA=data was not analyzed in the associated EIS.

Source: DOE 1995o; DOE 1995cc; Table 4.2.1.2–1.

4.7.2.1.3 *Air Quality and Noise*

Cumulative impacts to air quality at Hanford include impacts from the No Action Alternative, the two DOE programs identified in Table 4.7.1–1, and the proposed facilities for each storage alternative. Concentrations are calculated for these emissions and are then compared to Federal and State regulations and guidelines to determine compliance.

Hanford is currently in compliance with the NAAQS as well as State regulations and guidelines. Air emissions attributable to the Storage Alternatives would increase concentrations of criteria pollutants. Potential cumulative impacts are presented in Table 4.7.2.1.3–1. The resulting concentrations from cumulative impacts would be in compliance with Federal and State regulations.

Cumulative noise impacts include contributions from existing and planned facilities plus proposed storage facilities at the site. Noise impacts may result both from onsite noise sources and from offsite sources such as traffic. Noise impacts on individuals from the storage facilities are expected to be small, resulting in little or no

Table 4.7.2.1.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Hanford Site and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	No Action (μg/m³)	Other Onsite Activities[b] (μg/m³)	Upgrade (μg/m³)	Consolidation (μg/m³)	Collocation (μg/m³)
Criteria Pollutants							
Carbon monoxide	8-hour	10,000[c]	0.08	0	0.09	0.17	0.17
	1-hour	40,000[c]	0.3	0	0.37	1.04	1.04
Lead	Calendar Quarter	1.5[c]	<0.01	0	<0.01	<0.01	<0.01
	24-hour	0.5[d]	<0.01	0	<0.01	<0.01	<0.01
Nitrogen dioxide	Annual	100[c]	0.03	0.1	0.13	0.14	0.14
Ozone	1-hour	235[c]	e	e	e	e	e
Particulate matter less than or equal to 10 micron in diameter	Annual	50[c]	<0.01	0	<0.01	<0.01	<0.01
	24-hour	150[c]	0.02	0	0.02	0.02	0.02
Sulfur dioxide	Annual	52[c]	<0.01	1.6	1.61	1.61	1.61
	24-hour	260[c]	<0.01	7.3	7.31	7.31	7.31
	3-hour	1,300[c]	0.01	26	26.01	26.01	26.11
	1-hour	1,018[d]	0.02	f	0.02	0.22	0.22
	1-hour	655[d,g]	0.02	f	0.02	0.22	0.22
Mandated by Washington							
Total suspended particulates	Annual	60[d]	<0.01	0	<0.01	<0.01	<0.01
	24-hour	150[d]	0.02	0	0.02	0.02	0.02
Gaseous fluorides	30-day	0.8[d]	h	0	h	h	h
	7-day	1.7[d]	h	0	h	h	h
	24-hour	2.9[d]	h	0	h	h	h
	12-hour	3.7[d]	h	0	h	h	h

Table 4.7.2.1.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Hanford Site and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	No Action (μg/m³)	Other Onsite Activities[b] (μg/m³)	Upgrade (μg/m³)	Consolidation (μg/m³)	Collocation (μg/m³)
Hazardous and Other Toxic Compounds							
Ammonia	24-hour	100[d]	<0.01	0	<0.01	<0.01	<0.01
Chlorine	24-hour	5[d]	h	0	h	<0.01[i]	<0.01[i]
Hydrogen chloride	24-hour	7[d]	h	0	h	<0.01[i]	<0.01[i]
Hydrazine	Annual	0.0002[d]	h	0	h	<0.00001[i]	<0.00001[i]
Nitric acid	24-hour	17[d]	h	0	h	<0.01[i]	<0.01[i]
Phosphoric acid	24-hour	3.3[d]	h	0	h	<0.01[i]	<0.01[i]
Sulfuric acid	24-hour	3.3[d]	h	0	h	<0.01[i]	<0.01[i]

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.
[b] Other onsite activities include those associated with the Spent Nuclear Fuel and Waste Management Programs.
[c] Federal and State standard.
[d] State standard or guideline.
[e] 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.
[f] Not reported.
[g] The standard is not to be exceeded more than twice in any 7 consecutive days.
[h] No sources of this pollutant have been identified.
[i] The concentration represents the alternative contribution and other onsite activities.
Source: 40 CFR 50; DOE 1995o; DOE 1995dd; HF 1995a:1; HF DOE 1996a; Table 4.2.1.3–1.

increase in noise levels at offsite areas. Little or no increase in cumulative noise impacts to individuals offsite is expected to occur.

4.7.2.1.4 *Water Resources*

Table 4.7.2.1.4–1 shows the estimated cumulative water usage from the storage alternatives and the two other DOE programs identified in Table 4.7.1–1. The total cumulative water requirements for the site would be less than 1 percent of the Columbia River's average annual flow (3,360 m^3/s [118,642 ft^3/s]). The proposed storage Collocation Alternative would account for approximately 1 percent of the cumulative water usage. The additional withdrawals are minor in comparison with the average flow of the river and would not noticeably affect the local or regional water supply.

Table 4.7.2.1.4–2 summarizes the estimated cumulative wastewater that would be generated from the storage alternatives and the other two DOE programs. The wastewater from the Storage and Disposition Program would be recycled at newly constructed wastewater treatment facilities. [Text deleted.]

Table 4.7.2.1.4–1. Cumulative Annual Water Usage at Hanford Site

Program	Water Requirements (million l/yr)
No Action	13,706[a]
Storage and Disposition	150[b,c]
[Text deleted.]	
Spent Nuclear Fuel	0[d]
Waste Management	503[a,d]
Total annual cumulative water usage	14,359

[a] Includes both surface and groundwater usage (13,511 million l/yr from surface water and 195 million l/yr from groundwater).
[b] Data represents the maximum value for the comparative alternative scenario.
[c] Data represents the Collocation Alternative.
[d] No additional water resources are required.
Source: DOE 1995o; DOE 1995cc; DOE 1995dd; HF 1995a:1; Table 4.2.1.4–1.

Table 4.7.2.1.4–2. Cumulative Annual Wastewater Discharge at Hanford Site

Program	Nonhazardous Sanitary and Industrial Wastewater (million l/yr)
No Action	246
Storage and Disposition	0[a]
[Text deleted.]	
Spent Nuclear Fuel	0[b]
Waste Management	238[c,d]
Total annual cumulative wastewater	484

[a] Wastewater would be recycled.
[Text deleted.]
[b] Because the ROD resulted in the movement of material away from Hanford, no additional wastewater discharge would result.
[c] Data represents the maximum value for the comparative alternative scenario.
[d] Based on preliminary data.
Source: DOE 1995o; DOE 1995cc; DOE 1995dd; HF 1995a:1; Table 4.2.1.4–1.

4.7.2.1.5 *Geology and Soils*

Cumulative impacts to geologic and soil resources are expected to be minor as a result of the storage alternatives and the other DOE programs identified in Table 4.7.1-1. A total of 230 ha (570 acres) could be disturbed at the site. Soil erosion and storm water control measures would be used during construction to minimize erosion from the disturbed areas. No valuable geologic resources would be affected by any of the planned programs.

4.7.2.1.6 *Biological Resources*

In addition to ongoing activities and the Storage Alternatives, Hanford is being considered for the two other DOE programs identified in Table 4.7.1–1. The total area of undisturbed land that could be affected by these programs is 230 ha (570 acres), or less than 0.2 percent of Hanford. Due to the lack of wetlands and aquatic resources on the site, cumulative impacts to these resources would not be expected. The cumulative loss of habitat could lead to additional impacts to special status species compared to those resulting from construction of a storage facility alone; however, the viability of site populations would not be expected to be jeopardized. Species that could be affected include 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.

4.7.2.1.7 *Cultural and Paleontological Resources*

The two other DOE programs identified in Table 4.7.1–1 may require ground-disturbing construction, facility modification, and changes in land access at Hanford. Construction at Hanford under these programs is primarily proposed for developed areas which have either been surveyed or are disturbed, and are therefore unlikely to contain cultural or paleontological resources. Prior to construction activity, specific surveys, evaluations, and Native American consultations would be conducted pursuant to NHPA, the *American Indian Religious Freedom Act*, and the *Native American Graves Protection and Repatriation Act*. Each of the Storage Alternatives would be located either within existing buildings or in areas that have already been disturbed. Thus, the cumulative impacts resulting from the storage alternatives, if any, are expected to be minimal.

4.7.2.1.8 *Socioeconomics*

Cumulative impacts to Hanford's regional economy, population, housing, community services, and local transportation would be minor. Overall, adding the other DOE programs identified in Table 4.7.1–1 would confer economic benefits to the region through additional job creation and increased earnings. As shown in Table 4.7.2.1.8–1, the cumulative impact of the programs under consideration at Hanford is not expected to be significant because of the relatively small size of each program. The primary impact beyond providing some stimulus to the regional economy would be to increase traffic flow to and from the site. However, it is not expected that traffic congestion would be significantly increased if one or all of these programs were sited at Hanford.

Table 4.7.2.1.8–1. Socioeconomic Cumulative Impacts at Hanford Site

Program	Direct Employment[a]
Storage and Disposition[b]	572
Spent Nuclear Fuel	0
Waste Management	416
Total	988

[a] Operations.
[b] Collocation Alternative.
Source: DOE 1995o; DOE 1995cc; Section 4.2.1.8.

4.7.2.1.9 *Public and Occupational Health and Safety*

Radiological Impacts. The maximum incremental radiological doses and resulting health effects for the storage alternative, the No Action Alternative, and other actions planned at Hanford are presented in Table 4.7.2.1.9–1. The impacts of these actions have not been summed because the exact locations of the facilities for planned actions may change. In addition, because each of these facilities is sited in a different location, the location of the MEI for each is also different. The MEIs have been selected to maximize the potential dose for a given facility. Since the MEI would have to be resident at more than one location simultaneously in order to receive the maximum dose from each facility, summing the doses would be misleading. The offsite population and total site workforce doses have not been summed because the population distribution and workforce totals as analyzed vary among the actions. [Text deleted.]

Table 4.7.2.1.9–1. Estimated Average Annual Cumulative Radiological Doses and Resulting Health Effects to the Public and Workers From Normal Operation at Hanford Site

	Maximally Exposed Individual Member of the Public		Offsite Population Within 80 km		Total Site Workforce	
Program	Total Dose (mrem)	Fatal Cancer Risk	Total Dose (person-rem)	Number of Fatal Cancers	Total Dose (person-rem)	Number of Fatal Cancers
No Action	$5.3x10^{-3}$	$2.7x10^{-9}$	1.6	$7.7x10^{-4}$	250	0.10
Storage and Disposition[a]	$2.5x10^{-6}$	$1.3x10^{-12}$	$1.1x10^{-4}$	$5.5x10^{-8}$	25	0.010
[Text deleted.]						
Spent Nuclear Fuel	0.028	$1.4x10^{-8}$	1.6	$8.0x10^{-4}$	142	0.057
Waste Management	0.45	$2.2x10^{-7}$	22	0.011	0.35	$1.4x10^{-4}$

[a] The impacts from the collocation storage facility are presented since they encompass both Pu and HEU storage.
Source: DOE 1995o; DOE 1995cc; DOE 1995dd; Tables 4.2.1.9–1 and 4.2.1.9–2.

Chemical Impacts. For Hanford, the various NEPA documents use different but otherwise acceptable methodologies to assess the health effects from hazardous chemical exposure for proposed activities. These methodologies may have different indicators for determining the health impact (for example, hazard index, cancer risk, or chemical concentration in the environment). These different indicators prevent a uniform quantitative cumulative impact analysis for this site. However, as indicated in the health impact analysis sections in the NEPA documents for the proposed actions, the health effect from any proposed action at Hanford is predicted to contribute only slightly to the impacts from the baseline activity (No Action). The potential cumulative health impact from hazardous chemicals from implementation of the proposed activities would not exhibit a noticeable increase above the baseline, would be expected to fall within acceptable regulatory limits.

4.7.2.1.10 *Waste Management*

Cumulative impacts to waste management at Hanford could arise from any of the reasonably foreseeable future actions as identified in Table 4.7.2.1.10–1. Waste management activities associated with the storage of Pu and HEU would have consistently smaller impacts than any future environmental restoration and waste management activities at Hanford. Thus, the overall impacts of Pu and HEU storage would not contribute significantly to cumulative impacts. The largest cumulative impacts at Hanford result from the Waste Management PEIS under alternatives where Hanford is selected as a centralized treatment, storage, and/or disposal site, such as the HLW Centralized Alternative, the LLW Centralized Alternative 5, and the Mixed LLW Centralized Alternative. As a result of the ROD from the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Program Final*

Table 4.7.2.1.10–1. Waste Management Cumulative Impacts at Hanford Site (2005)—Annual Volumes

Category	No Action[a] (m^3)	Storage and Disposition[b] (m^3)	Spent Nuclear Fuel [c] (m^3)	Waste Management (m^3)	Total (m^3)
Spent Fuel	0	0	0	0	0
High Level					
Liquid	0	0	0	Included in solid	0
Solid	0	0	0	19,935[d]	19,935
Transuranic					
Liquid	0	0.02	Included in solid	Included in solid	0.02
Solid	271	10	53	675[e]	1,009
Mixed Transuranic					
Liquid	0	0	Included in TRU	Included in TRU	0
Solid	98	4	Included in TRU	Included in TRU	102
Low-Level					
Liquid	0	2.1	1,300	Included in solid	1,302
Solid	3,390	1,300	407	69,600[f]	74,700
Mixed Low-Level					
Liquid	3,760	0.2	Included in solid	Included in solid	3,760
Solid	1,505	66	0.46	9,655[g]	11,230
Hazardous					
Liquid	Included in solid	2	Included in solid	Included in solid	2
Solid	560	2	2	504[h]	1,068
Nonhazardous (Sanitary)					
Liquid	414,000	146,000	NA	NA	560,000
Solid	5,107	1,760	NA	NA	6,870

Table 4.7.2.1.10–1. Waste Management Cumulative Impacts at Hanford Site (2005)—Annual Volumes—Continued

Category	No Action[a] (m^3)	Storage and Disposition[b] (m^3)	Spent Nuclear Fuel [c] (m^3)	Waste Management (m^3)	Total (m^3)
Nonhazardous					
(Other)					
Liquid	Included in sanitary	Included in sanitary	NA	153,380[i]	153,380
Solid	Included in sanitary	2,200[i]	NA	NA	2,200

[a] No Action volumes are from Table 4.2.1.10–1.

[b] Collocation Alternative annual volume generated from operations, Table E.3.1.3–1.

[Text deleted.]

[c] The Department has decided to implement the preferred alternative, Regionalization by Fuel Type (Alternative 4a) identified in Volume 1 of the DOE Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final EIS. According to the amended ROD (61 FR 9441), existing Hanford production reactor spent nuclear fuel will remain at the Hanford Site. Data is from table 3–2, page 350, follow-on NEPA analysis, Management of Spent Nuclear Fuel from the K Basins at the Hanford Site, of Richland, Washington using preferred alternative (dry storage/passivation).

[Text deleted.]

[d] Under the HLW Centralized Alternative, 11,400 m^3 (8,500 canisters) of HLW shipments from INEL, 126,900 m^3 (4,572 canisters) from SRS, and 1,600 m^3 (300 canisters) from West Valley Demonstration Project would be transported to Hanford for storage. Hanford would have 258,800 m^3 (15,000 canisters) of HLW in storage. Annual volume derived by dividing total volume by 20. Acceptance of DOE-managed HLW at the geologic repository is delayed past 2015 (Draft Waste Management PEIS, Vol. I of IV, Table 9.1–1 Page 9-3; Table 9-3-6; Page 9-22).

[e] Under the TRU Waste Centralized Alternative, Hanford would treat 10 percent of the estimated inventory plus 20 year generation of RH-TRU from INEL and LANL (Draft Waste Management PEIS, Vol. I of IV, Table 8.1–1, Page 8-4).

[f] Under the LLW Centralized Alternative 5, Hanford would receive LLW from all sites. The volume was obtained by taking the estimated inventory at Hanford plus the estimated inventory and 20-year generation projection for offsite receipts and dividing by 20 to get annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 7.1–1, Page 7-3; Table 7.3–14, Page 7-28).

[g] Under the Mixed LLW Centralized Alternative, Hanford would receive mixed LLW from all sites. The volume was obtained by taking the annual estimate the estimated inventory at Hanford plus the estimated inventory and 20-year generation projection for offsite receipts and dividing by 20 to get annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 6.3–7, Page 6-24; Table 6.1–1, Pages 6-3 and 6-4).

[h] Under the Regionalized Alternative 1, Hanford would treat two-thirds of 50 percent of the received hazardous wastes from LLNL and send the other one-third to a commercial facility. One metric ton of hazardous waste is approximately 1 cubic meter in volume (Draft Waste Management PEIS, Vol. I of IV, Table 10.3–7, Page 10-20).

[i] Represents the total annual incremental wastewater over No Action for all alternatives. Annual volume estimated by assuming 365 days per year (Draft Waste Management PEIS, Vol. II, Tables II-5.1–16 [mixed LLW], page 5–18; II-5.2–12 [LLW], page 5–32; II-5.3–11 [TRU], page 5–45; II-5.4–8 [HLW], page 5–55; and II-5.5–10 [hazardous], page 5–67).

Note: NA=data was not analyzed in the associated EIS.

Source: 61 FR 9441; DOE 1995o; DOE 1995cc; DOE 1995dd; DOE 1996b; Table 4.2.1.10–1.

Environmental Impact Statement, Hanford will not receive spent nuclear fuel from domestic offsite sources, and thus would not contribute significantly to spent nuclear fuel cumulative impacts. However, additional waste volumes would be generated from the storage of existing inventories.

4.7.2.2 Nevada Test Site

4.7.2.2.1 *Land Resources*

In addition to the storage alternatives, NTS is under consideration for the siting of the two other DOE programs identified in Table 4.7.1-1. The total area of undisturbed land that could be affected by these programs during operation is 111 ha (276 acres), or less than 0.04 percent of the total land at NTS. The site development plans for the P-Tunnel alternative in Area 12 and the storage facilities in Area 6 do not conform with land use plans outlined in the *Nevada Test Site Development Plan*. However, all new development projects are in accordance with the land use plans outlined in the Expanded Use Alternative of the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*. The proposed development would be compatible with the industrial use visual character of the developed areas of NTS. Cumulatively, the actions would consume land, but would be consistent with the land use plans and visual character of the site.

4.7.2.2.2 *Site Infrastructure*

Some cumulative impacts are possible at NTS resulting from implementation of any of the storage actions when added to the other two DOE programs identified in Table 4.7.1–1. Currently, the United States is under a self-imposed nuclear testing moratorium. Should a decision be made to reinstate the underground test program, NTS would again restore all of the dormant infrastructure. Operational procedures across the site would also be affected if underground testing resumes, creating cumulative impacts upon the other programs. Table 4.7.2.2.2–1 shows the site infrastructure cumulative impacts that would result at NTS from operation of the proposed programs were they to be sited at NTS. The cumulative requirement for energy, peak load, oil, and natural gas would exceed the site availability at NTS. High voltage transmission lines, electrical distribution equipment, and oil storage tanks would be constructed to meet the new resource requirements. Oil-based utilities would be substituted for the natural gas utilities if needed.

Table 4.7.2.2.2–1. Site Infrastructure Cumulative Operation Impacts at Nevada Test Site

	Electrical		Fuel	
Requirement	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Natural Gas (m^3/yr)
No Action	124,940	25	5,716,000	0
Storage and Disposition[a]	89,000	13	38,000	3,600,000
Stockpile Stewardship and Management	83,000	27	4,332,000	0
Waste Management	NA	11	NA	NA
Cumulative Requirement	296,940	76	10,086,000	3,600,000
Site Availability	176,844	45	5,716,000	0

[a] Collocation Alternative.

Note: NA=data was not analyzed in the associated EIS.

Source: DOE 1995cc; DOE 1996b; Table 4.2.2.2–1.

4.7.2.2.3 *Air Quality and Noise*

Cumulative impacts to air quality at NTS include impacts from the No Action Alternative, the other two DOE programs identified in Table 4.7.1–1, and the proposed facilities for each alternative. Concentrations are calculated for these emissions and are then compared to Federal and State regulations and guidelines to determine compliance.

The NTS is currently in compliance with the NAAQS as well as State regulations and guidelines. Air emissions attributable to the storage alternatives would increase concentrations of criteria pollutants. Potential cumulative impacts are presented in Table 4.7.2.2.3–1. The resulting concentrations from cumulative impacts would be in compliance with Federal and State regulations.

Cumulative noise impacts include contributions from existing and planned facilities plus proposed storage facilities at the site. Noise impacts may result both from onsite noise sources and from offsite sources such as traffic. Noise impacts on individuals from the storage facilities are expected to be small, resulting in little or no increase in noise levels at offsite areas. Little or no increase in cumulative noise impacts to individuals offsite is expected to occur.

4.7.2.2.4 *Water Resources*

Table 4.7.2.2.4–1 summarizes the estimated cumulative water withdrawals for the storage alternatives and the two other DOE programs identified in Table 4.7.1–1. Water requirements during the operation of all the proposed projects would be obtained from groundwater resources. The cumulative water requirements for the site would be a 26-percent increase in the projected No Action usage and approximately 7.2 percent of the estimated minimum recharge rate. The proposed Collocation Alternative using the modify P-Tunnel option would account for approximately 6.4 percent of the cumulative water usage.

Because all wastewater generated during operations of the proposed facilities would be recycled, the amount of wastewater generated during construction was evaluated. Table 4.7.2.2.4–2 summarizes the estimated cumulative water discharges. The estimated cumulative wastewater discharge would be a 178-percent increase in the projected No Action discharge. The proposed collocation alternative using a new storage facility would account for approximately 5 percent of the total estimated cumulative wastewater. [Text deleted.]

Table 4.7.2.2.4–1. Cumulative Annual Water Usage at Nevada Test Site

Program	Water Requirements (million l/yr)
No Action	2,400[a]
Storage and Disposition	190[b]
Stockpile Stewardship and Management	250
Waste Management	147[c]
Total annual cumulative water usage	2,987

[a] Data represents groundwater usage.
[b] Data represents the Collocation Alternative using the modify P-Tunnel option.
[c] Based on preliminary data.
Source: DOE 1995cc; DOE 1996b; NTS 1995a:1; Table 4.2.2.4–1.

Table 4.7.2.2.4–2. Cumulative Annual Wastewater Discharge at Nevada Test Site

Program	Nonhazardous Sanitary and Industrial Wastewater (million l/yr)
No Action	82.0
Storage and Disposition	11.8[a]
Stockpile Stewardship and Management	72
Waste Management	61[b]
Total annual cumulative wastewater	227

[a] Data represents the maximum value for the comparative scenario during construction of the Collocation Alternative using a new storage facility.
[b] Based on preliminary data.
Source: DOE 1995cc; DOE 1996b; NTS 1995a:1; Table 4.2.2.4–1.

Table 4.7.2.2.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Nevada Test Site and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	No Action (μg/m³)	Other Onsite Activities[b] (μg/m³)	Consolidation: Modify P-Tunnel (μg/m³)	Consolidation: New Facility (μg/m³)	Collocation: Modify P-Tunnel (μg/m³)	Collocation: New Facility (μg/m³)
Criteria Pollutants								
Carbon monoxide	8-hour	10,000[c]	2,290	0.80	2,291	2,291	2,291	2,291
	1-hour	40,000[c]	2,748	6.03	2,758	2,756	2,758	2,756
Lead	Calendar Quarter	1.5[c]	[d]	<0.01	[d]	[d]	[d]	[d]
Nitrogen dioxide	Annual	100[c]	[d]	0.20	0.21[e]	0.2[e]	0.21[e]	0.2[e]
Ozone	1-hour	235[c]	[f]	[f]	[f]	[f]	[f]	[f]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[c]	9.4	0	9.4	9.4	9.4	9.4
	24-hour	150[c]	106	0	106	106	106	106
Sulfur dioxide	Annual	80[c]	8.4	0	8.4	8.4	8.4	8.4
	24-hour	365[c]	94.6	0.2	94.8	94.8	94.8	94.8
	3-hour	1,300[c]	725	1.6	727	727	727	727
Mandated by Nevada								
Hydrogen sulfide	1-hour	112[g]	[d]	0	[d]	[d]	[d]	[d]
Hazardous and Other Toxic Compounds								
Chlorine	8-hour	35.7[g]	[d]	[d]	<0.01[e]	<0.01[e]	<0.01[e]	<0.01[e]
Hydrogen chloride	8-hour	[h]	[d]	[d]	<0.01[e]	<0.01[e]	<0.01[e]	<0.01[e]
Hydrazine	8-hour	3.1[g]	[d]	[d]	<0.01[e]	<0.01[e]	<0.01[e]	<0.01[e]
Nitric acid	8-hour	123.8[g]	[d]	[d]	<0.01[e]	<0.01[e]	<0.01[e]	<0.01[e]
Phosphoric acid	8-hour	23.8[g]	[d]	[d]	<0.01[e]	<0.01[e]	<0.01[e]	<0.01[e]
Sulfuric acid	8-hour	23.8[g]	[d]	[d]	<0.01[e]	<0.01[e]	<0.01[e]	<0.01[e]

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.
[b] Other onsite activities include those associated with the Stockpile Stewardship and Management and Waste Management programs.
[c] Federal and State standard.
[d] No sources of this pollutant have been identified.
[e] The concentration represents the alternative contribution and other onsite activities.
[f] 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.
[g] State standard or guideline.
[h] No State standard for indicated averaging time.
Source: 40 CFR 50; DOE 1995dd; DOE 1996b; NT DOE 1996a; NV DCNR 1992a; NV DCNR 1995a; Table 4.2.2.3–1.

4.7.2.2.5 *Geology and Soils*

Cumulative impacts to geologic and soil resources are expected to be minor as a result of the storage alternatives and the other DOE programs identified in Table 4.7.1–1. A total of 111 ha (276 acres) could be disturbed at the site. Soil erosion and storm water control measures would be used during construction to minimize erosion from the disturbed areas. No valuable geologic resources would be affected by any of the planned programs.

4.7.2.2.6 *Biological Resources*

In addition to ongoing activities and the Storage Alternatives, NTS is being considered for the two other programs identified in Table 4.7.1–1. A number of these facilities would be located to the south and west of Yucca Lake in Areas 5 and 6, although the collocated storage facility could alternatively be located at the P-Tunnel. The total area of undeveloped land used by new facilities would be 111 ha (276 acres), or less than 0.04 percent of NTS. Due to the lack of wetlands and aquatic resources at NTS, cumulative impacts to these resources would not be expected. To the extent that facilities were constructed within the southern portion of the site, cumulative impacts to the threatened desert tortoise could occur. Cumulative impacts to other special status species, such as the Beatley milkvetch, could also occur due to the additive effect of habitat loss.

4.7.2.2.7 *Cultural and Paleontological Resources*

The two other DOE programs identified in Table 4.7.1–1 may require ground-disturbing construction, facility modification, and changes in land access and use at NTS. Much of the land potentially affected by construction has received some level of evaluation for cultural resources. Plant communities significant to Native Americans may be affected on Rainier Mesa and near the DAF. Prior to construction activity, specific surveys, evaluations, and Native American consultations would be conducted pursuant to NHPA, the *American Indian Religious Freedom Act*, and the *Native American Graves Protection and Repatriation Act*. Cumulative impacts resulting from the storage alternatives, if any, are expected to be minimal.

4.7.2.2.8 *Socioeconomics*

Cumulative impacts on NTS's regional economy, population, housing, community services, and local transportation would be minor. Table 4.7.2.2.8–1 shows the socioeconomic cumulative impacts at NTS. The regional economy would improve without any burden on the housing market. The cumulative socioeconomic impact of the other two DOE programs is expected to be insignificant, due to the relatively small size of each program.

Table 4.7.2.2.8–1. Socioeconomic Cumulative Impacts at Nevada Test Site

Program	Direct Employment[a]
Storage and Disposition[b]	622
Stockpile Stewardship and Management	1,423
Waste Management	3,272
Total	5,317

[a] Operations.

[b] Collocation Alternative.

Source: DOE 1995cc; DOE 1996b; Section 4.2.2.8.

4.7.2.2.9 *Public and Occupational Health and Safety*

Radiological Impacts. The maximum incremental radiological doses and resulting health effects for the Storage Alternative, the No Action Alternative, and other actions planned at NTS are presented in Table 4.7.2.2.9–1. Although these impacts could be added, it should be noted that the exact locations of the

Table 4.7.2.2.9–1. Estimated Average Annual Cumulative Radiological Doses and Resulting Health Effects to the Public and Workers From Normal Operation at Nevada Test Site

	Maximally Exposed Individual Member of the Public		Offsite Population Within 80 km		Total Site Workforce	
Program	**Total Dose (mrem)**	**Fatal Cancer Risk**	**Total Dose (person-rem)**	**Number of Fatal Cancers**	**Total Dose (person-rem)**	**Number of Fatal Cancers**
No Action	4.2×10^{-3}	2.1×10^{-9}	3.7×10^{-3}	1.9×10^{-6}	3	1.2×10^{-3}
Storage and Disposition[a]	5.6×10^{-6}	2.8×10^{-12}	1.7×10^{-6}	8.5×10^{-10}	40	0.016
Stockpile Stewardship and Management	3.5×10^{-6}	1.8×10^{-12}	3.1×10^{-6}	1.6×10^{-9}	2.6	1.0×10^{-3}
Waste Management	7.8×10^{-9}	3.9×10^{-15}	3.0×10^{-8}	1.5×10^{-11}	8.4×10^{-8}	3.4×10^{-11}
[Text deleted.]						

[a] The impacts from the collocation storage facility are presented since they encompass both Pu and HEU storage at P-Tunnel.
[Text deleted.]
Source: DOE 1995cc; DOE 1995dd; DOE 1996b; NT DOE 1986b; Tables 4.2.2.9–1 and 4.2.2.9–2.

facilities for planned actions may change. In addition, because each of these facilities is sited in a different location, the location of the MEI for each is also different. The MEIs have been selected to maximize the potential dose for a given facility. Since the MEI would have to be resident at more than one location simultaneously in order to receive the maximum dose from each facility, summing the doses would be misleading. The offsite population and total site workforce doses have not been summed because the population distribution and workforce totals as analyzed vary among the actions. [Text deleted.]

Chemical Impacts. For NTS, the various NEPA documents use different but otherwise acceptable methodologies to assess the health effects from hazardous chemical exposure for proposed activities. These methodologies may have different indicators for determining the health impact (for example, hazard index, cancer risk, or chemical concentration in the environment). These different indicators prevent a uniform quantitative cumulative impact analysis for this site. However, as indicated in the health impact analysis sections in the NEPA documents for the proposed actions, the health effect from any proposed action at NTS is predicted to contribute only slightly to the impacts from the baseline activity (No Action). The potential cumulative health impact from hazardous chemicals from implementation of the proposed activities would not exhibit a noticeable increase above the baseline, would be expected to fall within acceptable regulatory limits.

4.7.2.2.10 *Waste Management*

The actions and alternatives which could contribute to the cumulative impacts at NTS are listed in Table 4.7.2.2.10–1. The largest impact on radioactive waste management would result if NTS is selected as a regional treatment and disposal facility for mixed LLW and a central disposal facility for LLW as a result of the waste-type specific RODs developed from the Waste Management PEIS. The next smaller impact would result from the alternatives considered in this PEIS. NTS is also a candidate site for an Assembly/Disassembly facility and the National Ignition Facility from the Stockpile Stewardship and Management PEIS.

Table 4.7.2.2.10–1. Waste Management Cumulative Impacts at Nevada Test Site (2005)—Annual Volumes

Category	No Action[a] (m^3)	Storage and Disposition[b] (m^3)	Stockpile Stewardship and Management[c] (m^3)	Waste Management (m^3)	Total (m^3)
Spent Fuel	0	0	0	0	0
High Level					
Liquid	0	0	0	0	0
Solid	0	0	0	0	0
Transuranic					
Liquid	0	0.02	0	Included in solid	0.02
Solid	0	10	0	30.5[d]	40.5
Mixed Transuranic					
Liquid	0	0	0	Included in TRU	0
Solid	0	4	0	Included in TRU	4
Low-Level					
Liquid	Dependent on restoration activities	2.1	0.66	Included in solid	2.8
Solid	15,000	1,300	33	74,000[e]	90,330
Mixed Low-Level					
Liquid	0	0.2	2	Included in solid	2.2
Solid	50	66	2	11,300[f]	11,420
Hazardous					
Liquid	Included in solid	2	8	0	10
Solid	212	2	8	0	222
Nonhazardous (Sanitary)					
Liquid	Included in solid	189,000	70,900	NA	260,000
Solid	2,120	1,960	6,100	NA	10,180

Table 4.7.2.2.10–1. Waste Management Cumulative Impacts at Nevada Test Site (2005)—Annual Volumes—Continued

Category	No Action[a] (m^3)	Storage and Disposition[b] (m^3)	Stockpile Stewardship and Management[c] (m^3)	Waste Management (m^3)	Total (m^3)
Nonhazardous					
(Other)					
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	36,300[g]	36,300
Solid	76,500	2,500[h]	0	NA	79,000

[a] No Action volumes are from Table 4.2.2.10–2.

[b] Collocation Alternative using modification of P-Tunnel, Table E.3.1.3–2.

[c] Assembly/disassembly and National Ignition Facility alternatives.

[d] Represents the Decentralized Alternative in which NTS would treat and store its TRU waste onsite, and dispose of it at a Federal geologic repository. The number is the existing inventory divided by 20 from Table 8.1–1, page 8-4 of the Draft Waste Management PEIS (DOE/EIS-0200D).

[e] Represents the LLW Centralized Alternative 2 in which NTS would dispose of DOE LLW. The volume was obtained by taking the estimated inventory at NTS plus the estimated inventory and 20-year generation projection for offsite receipts and dividing by 20 to get annual estimate (Table 7.1–1, page 7-3 of the Draft Waste Management PEIS).

[f] Represents the mixed LLW Regionalized Alternative 3 in which NTS would ship its mixed LLW to INEL for treatment. NTS would then dispose of all DOE treated mixed LLW. The volume was obtained by taking the estimated inventory at NTS plus the estimated inventory and 20-year generation projection for offsite receipts and dividing by 20 to get annual estimate (Table 6.1–1, page 6-3 of the Draft Waste Management PEIS).

[g] Represents the total annual incremental wastewater for all alternatives (Draft Waste Management PEIS, Vol. II; Tables II-9.3-11 [TRU], page 9-42; II-9.2–11 [LLW], page 9-28; and II-9.1-14 [mixed LLW], page 9-15).

[h] Recyclable waste.

Note: NA=data was not analyzed in the associated EIS.

Source: DOE 1995cc; DOE 1995dd; DOE 1996b; Table 4.2.2.10–1.

4.7.2.3 Idaho National Engineering Laboratory

4.7.2.3.1 *Land Resources*

In addition to the storage alternatives, INEL is being considered as a site for the three other DOE programs identified in Table 4.7.1–1. The total area of undisturbed land that could be affected by these programs during operation is 328 ha (812 acres), or less than 0.2 percent of the total land at INEL. Site development would be performed in accordance with the land-use plans in the *INEL Site Development Plan*. Proposed development would also be compatible with the industrial use visual character of the developed areas of INEL. Cumulatively, the actions would consume land, but would be consistent with the land-use plans and visual character of the site.

4.7.2.3.2 *Site Infrastructure*

Some cumulative impacts are possible from siting the storage alternatives at INEL if facilities resulting from the three other DOE programs identified in Table 4.7.1–1 are also located at INEL. The site infrastructure cumulative impacts that would result at INEL from operation of all the proposed projects are shown in Table 4.7.2.3.2–1. INEL has adequate site availability for all of the site infrastructure resource requirements except for coal. Additional coal requirements would be satisfied using the current procurement practices at the site.

Table 4.7.2.3.2–1. Site Infrastructure Cumulative Impacts at Idaho National Engineering Laboratory

	Electrical		Fuel	
Requirement	**Energy (MWh/yr)**	**Peak Load (MWe)**	**Oil (l/yr)**	**Coal (t/yr)**
No Action	232,500	42	5,820,000	11,340
Storage and Disposition	58,000[a]	10[a]	140,000[b]	14,000[a]
Foreign Research Reactor Spent Nuclear Fuel	1,000	NA	NA	NA
Spent Nuclear Fuel	2,200	NA	330,000	NA
Waste Management	NA	15.8	NA	NA
Cumulative Requirement	293,700	67.8	6,290,000	25,340
Site Availability	394,200	124	16,000,000	11,340

[a] Collocation Alternative.

[b] Upgrade with All or Some RFETS and LANL Pu material alternative.

Note: NA=data was not analyzed in the associated EIS.

Source: DOE 1995j; DOE 1995cc; DOE 1996g; Table 4.2.3.2–1.

4.7.2.3.3 *Air Quality and Noise*

Cumulative impacts to air quality at INEL include impacts from the No Action Alternative emissions, three other DOE programs identified in Table 4.7.1–1, and the proposed facilities for each alternative. Concentrations are calculated for these emissions and are then compared to Federal and State regulations and guidelines to determine compliance.

The INEL is currently in compliance with the NAAQS as well as State regulations and guidelines. Air emissions attributable to the storage alternatives would increase concentrations of criteria pollutants. Potential cumulative impacts are presented in Table 4.7.2.3.3–1. The resulting concentrations from cumulative impacts would be in compliance with Federal and State regulations.

Cumulative noise impacts include contributions from existing and planned facilities plus proposed storage facilities at the site. Noise impacts may result both from onsite noise sources and from offsite sources such as

Table 4.7.2.3.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Idaho National Engineering Laboratory and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	No Action (μg/m³)	Other Onsite Activities[b] (μg/m³)	Upgrade (μg/m³)	Consolidation (μg/m³)	Collocation (μg/m³)
Criteria Pollutants							
Carbon monoxide	8-hour	10,000[c]	284	18	302.4	303.4	303.6
	1-hour	40,000[c]	614	605	1220	1222	1223
Lead	Calendar Quarter	1.5[c]	0.001	0.004	0.005	0.005	0.005
Nitrogen dioxide	Annual	100[c]	4	7	11.02	11.73	11.91
Ozone	1-hour	235[c]	d	d	d	d	d
Particulate matter less than or equal to 10 microns in diameter	Annual	50[c]	5	0	5.01	5.05	5.06
Sulfur dioxide	24-hour	150[c]	80	6	86.14	86.98	87.17
	Annual	80[c]	6	0	6.01	7.25	7.53
	24-hour	365[c]	135	2	137.3	160.5	165.7
	3-hour	1,300[c]	579	12	592.2	693.3	716.2
Mandated by Idaho							
Total suspended particulate	Annual	60[e]	5	0	5.1	5.05	5.06
	24-hour	150[e]	80	6	86.4	86.98	87.17
Hazardous and Other Toxic Compounds							
Ammonia	Annual	180[f]	6.0	0.0007	6.0	6.0	6.0
Chlorine	Annual	30[f]	g	0	g	<0.01[h]	<0.01[h]
Hydrogen chloride	Annual	7.5[f]	0.98	0.092	1.07	1.07	1.07
Hydrazine	Annual	0.00034[f]	0.000001	0	0.000001	0.000004	<0.000004
Mercury	Annual	1[f]	0.042	0.0014	0.0434	0.0434	0.0434
Nitric acid	Annual	50[f]	0.64	0.0013	0.6413	0.6413	0.6413

Table 4.7.2.3.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Idaho National Engineering Laboratory and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	No Action (μg/m³)	Other Onsite Activities[b] (μg/m³)	Upgrade (μg/m³)	Consolidation (μg/m³)	Collocation (μg/m³)
Hazardous and Other Toxic Compounds (continued)							
Phosphoric acid	Annual	10[f]	[g]	0	[g]	<0.01[h]	<0.01[h]
Sulfuric acid	Annual	10[f]	[g]	0.00085	[g]	<0.01[h]	<0.01[h]
Trivalent chromium	Annual	5[f]	0.036	0.0004	0.03604	0.03604	0.03604

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.
[b] Other onsite activities include those associated with the Foreign Research Reactor Spent Nuclear Fuel, Spent Nuclear Fuel Management and Waste Management programs.
[c] Federal and State standard.
[d] 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.
[e] State standard or guideline
[f] Acceptable air concentrations listed in Rules for the Control of Air Pollution in Idaho apply only to new (not existing) sources and are used here only as reference levels.
[g] No sources of this pollutant have been identified.
[h] The concentration represents the alternative contribution and other onsite activities.

Source: 40 CFR 50; DOE 1995j; DOE 1995dd; DOE 1996b; DOE 1996g; FDI 1996a:1; ID DHW 1995a; ID DHW 1995c; IN DOE 1996a; Table 4.2.3.3–1.

traffic. Noise impacts on individuals from the storage facilities are expected to be small, resulting in little or no increase in noise levels at offsite areas. Little or no increase in cumulative noise impacts to individuals offsite is expected to occur.

4.7.2.3.4 *Water Resources*

Table 4.7.2.3.4–1 summarizes the estimated cumulative water usage for the storage alternatives and the three other DOE programs identified in Table 4.7.1–1. Water requirements during the operation of all the proposed projects would be obtained from groundwater resources. The cumulative water requirements for the site would be a 6-percent increase over the projected No Action water usage, or approximately 18.3 percent of the groundwater allotment. The operation of the Collocation Alternative would account for approximately 1.1 percent of the total annual cumulative water usage.

Because all wastewater could be recycled during operation, wastewater generated during construction would have the most impact. Table 4.7.2.3.4–2 summarizes the estimated volumes of cumulative wastewater discharged to ponds or recycled. The cumulative wastewater discharged would be a 27-percent increase in the projected discharge. Existing INEL treatment facilities could accommodate all the new cumulative process and wastewater streams.

Table 4.7.2.3.4–1. Cumulative Annual Water Usage at Idaho National Engineering Laboratory

Program	Water Requirements (million l/yr)
No Action	7,570[a]
Storage and Disposition	87[b,c]
Foreign Research Reactor Spent Nuclear Fuel	2.1[b]
Spent Nuclear Fuel	49
Waste Management	353[b,d]
Total annual cumulative water usage	8061.1

[a] Data represents groundwater usage.
[b] Data represents maximum value for the comparative scenario.
[c] Date represent the Collocation Alternative.
[d] Based on preliminary data.
Source: DOE 1995j; DOE 1995dd; DOE 1996g; INEL 1995a:1; Table 4.2.3.4–1.

Table 4.7.2.3.4–2. Cumulative Annual Wastewater Discharge at Idaho National Engineering Laboratory

Program	Nonhazardous Sanitary and Industrial Wastewater (million l/yr)
No Action	540
Storage and Disposition	12.8[a,b]
Foreign Research Reactor Spent Nuclear Fuel	1.6[a]
Spent Nuclear Fuel	49
Waste Management	85[a,c]
Total annual cumulative wastewater	688.4

[a] Data represents the Collocation Alternative during construction.
[b] Data represents maximum value for the comparative scenario.
[c] Based on preliminary data.
Source: DOE 1995j; DOE 1995dd; DOE 1996g; INEL 1995a:1; Table 4.2.3.4–1.

4.7.2.3.5 *Geology and Soils*

Cumulative impacts to geologic and soil resources are expected to be minor as a result of the storage alternatives and the other DOE programs identified in Table 4.7.1–1. A total of 328 ha (812 acres) could be disturbed at the site. Soil erosion and storm water control measures would be used during construction to minimize erosion from the disturbed areas. No valuable geologic resources would be affected by any of the planned programs.

4.7.2.3.6 *Biological Resources*

In addition to ongoing activities and the storage alternatives, INEL is being considered for the three other DOE programs identified in Table 4.7.1–1. Although many of these facilities would be located within developed areas of the site, certain environmental restoration and waste management facilities and consolidated or collocated storage facilities would be constructed on undeveloped land. The total area of undeveloped land required would be 328 ha (812 acres), or less than 0.2 percent of INEL. Due to the general lack of wetlands and aquatic resources at INEL, and the fact that facilities would be constructed away from the Big Lost River, cumulative impacts to these resources would not be expected. The cumulative loss of habitat could lead to additional impacts to special status species compared to those resulting from construction of a storage facility alone; however, their status on INEL would not be expected to be jeopardized. Species that could be affected include several State-status species such as the pygmy rabbit, a number of bat species, and oxytheca.

4.7.2.3.7 *Cultural and Paleontological Resources*

The three other DOE programs identified in Table 4.7.1–1 may require ground-disturbing construction, facility modification, and changes in land access and use at INEL. Construction at INEL under these programs is primarily proposed for developed areas which have either been surveyed or are disturbed and are therefore unlikely to contain cultural or paleontological resources. Prior to construction activity, specific surveys, evaluations, and Native American consultations would be conducted pursuant to NHPA, the *American Indian Religious Freedom Act*, and the *Native American Graves Protection and Repatriation Act*. Cumulative impacts resulting from the storage alternatives, if any, are expected to be minimal.

4.7.2.3.8 *Socioeconomics*

Cumulative impacts on INEL's regional economy, population, housing, community services, and local transportation would be minor. Generally, the regional economy would improve without burdening the housing market, but new traffic could lead to congestion on local roads. Table 4.7.2.3.8–1 shows the other DOE programs that are being considered at INEL. Because each of these programs is relatively small, their cumulative socioeconomic impact would be minor. The primary impact will be to stimulate regional economic growth. If all of these programs were located at INEL, transportation congestion could result as well as the demand for new housing and other public services. However, housing construction trends indicate that this additional population could be accommodated without significant impacts to the housing market.

Table 4.7.2.3.8–1. Socioeconomic Cumulative Impacts at Idaho National Engineering Laboratory

Program	Direct Employment[a]
Storage and Disposition[b]	561
Foreign Research Reactor Spent Nuclear Fuel	30
Spent Nuclear Fuel	0
Waste Management	4,925
Total	5,516

[a] Operations.

[b] Collocation Alternative.

Source: DOE 1996g; DOE 1995j; DOE 1995cc; Section 4.2.3.8.

4.7.2.3.9 *Public and Occupational Health and Safety*

Radiological Impacts. The maximum incremental radiological doses and resulting health effects for the storage alternative, the No Action Alternative and other actions planned at INEL, are presented Table 4.7.2.3.9–1. Although these impacts could be added, it should be noted that the exact locations of the facilities for planned actions may change. In addition, because each of these facilities is sited in a different location, the location of the MEI for each is also different. The MEIs have been selected to maximize the potential dose for a given facility. Since the MEI would have to be resident at more than one location simultaneously in order to receive the maximum dose from each facility, summing the doses would be misleading. The offsite population and total site workforce doses have not been summed because the population distribution and workforce totals as analyzed vary among the actions. [Text deleted.]

Chemical Impacts. For INEL, the various NEPA documents use different but otherwise acceptable methodologies to assess the health effects from hazardous chemical exposure for proposed activities. These methodologies may have different indicators for determining the health impact (for example, hazard index, cancer risk, or chemical concentration in the environment). These different indicators prevent a uniform quantitative cumulative impact analysis for this site. However, as indicated in the health impact analysis sections in the NEPA documents for the proposed actions, the health effect from any proposed action at INEL is predicted to contribute only slightly to the impacts from the baseline activity (No Action). The potential cumulative health impact from hazardous chemicals from implementation of the proposed activities would not exhibit a noticeable increase above the baseline, would be expected to fall within acceptable regulatory limits.

Table 4.7.2.3.9–1. Estimated Average Annual Cumulative Radiological Doses and Resulting Health Effects to the Public and Workers From Normal Operation at Idaho National Engineering Laboratory

	Maximally Exposed Individual Member of the Public		Offsite Population Within 80 km		Total Site Workforce	
Program	**Total Dose (mrem)**	**Fatal Cancer Risk**	**Total Dose (person-rem)**	**Number of Fatal Cancers**	**Total Dose (person-rem)**	**Number Fatal Cancers**
No Action	0.018	$9.0x10^{-9}$	2.4	$1.2x10^{-3}$	220	0.088
Storage and Disposition[a]	$1.6x10^{-6}$	$8.0x10^{-13}$	$1.8x10^{-5}$	$9.0x10^{-9}$	25	0.010
Foreign Research Reactor Spent Nuclear Fuel	$5.6x10^{-4}$	$2.8x10^{-10}$	$4.5x10^{-3}$	$2.3x10^{-6}$	33	0.013
Spent Nuclear Fuel	$8.0x10^{-3}$	$4.0x10^{-9}$	0.19	$9.5x10^{-5}$	5.4	$2.2x10^{-3}$
Waste Management	1.0	$5.2x10^{-7}$	8.4	$4.2x10^{-3}$	2.5	$1.0x10^{-3}$

[a] The impacts from the collocation storage facility are presented since they encompass both Pu and HEU storage.
Source: DOE 1995j; DOE 1995dd; DOE 1996g; Tables 4.2.3.9–1 and 4.2.3.9–2.

4.7.2.3.10 *Waste Management*

The actions and alternatives which could contribute to the cumulative impacts at INEL are listed in Table 4.7.2.3.10–1. The largest impact on radioactive waste management would result if INEL is selected as a regional treatment and disposal facility for LLW and mixed LLW or as a regional treatment facility for TRU waste as a result of the waste-type-specific RODs developed from the Waste Management PEIS. The next largest impact would result from the alternative considered in this PEIS for the Collocation Alternative for long-term storage analyzed for INEL. The *Department of Energy Programmatic Spent Nuclear Fuel and Idaho National Engineering Laboratory Environmental Restoration Waste Management Programs EIS* and the *Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel EIS* would have smaller impacts at INEL.

Table 4.7.2.3.10–1. Waste Management Cumulative Impacts at Idaho National Engineering Laboratory (2005)—Annual Volumes

Category	No Action[a] (m^3)	Storage and Disposition[b] (m^3)	Foreign Research Reactor Spent Nuclear Fuel[c] (m^3)	Spent Nuclear Fuel Management[d] (m^3)	Waste Management (m^3)	Total (m^3)
Spent Fuel	0	0	1.0 t	165 t	0	166 t
High Level						
Liquid	538	0	0	27	0	565
Solid	192	0	0	Included in liquid	0[e]	192
Transuranic						
Liquid	0	0.02	0	32	Included in solid	32
Solid	3.5	10	0	Included in liquid	2,790[f]	2,804
Mixed Transuranic						
Liquid	Included in TRU	0	0	Included in TRU	Included in TRU	0
Solid	Included in TRU	4	0	Included in TRU	Included in TRU	4
Low-Level						
Liquid	0	2.1	0	0	Included in solid	2.1
Solid	7,200	1,300	23	197	11,870[g]	20,600
Mixed Low-Level						
Liquid	4	0.2	0	0	Included in solid	4.4
Solid	170	66	0	0	2,725[h]	2,960
Hazardous						
Liquid	Included in solid	2	0	0	Included in solid	2
Solid	1,200	2	0	0	1,854[i]	3,056
Nonhazardous (Sanitary)						
Liquid	Included in solid	86,800	1,990	0	NA	88,740
Solid	52,000	1,720	NA	0	NA	53,720

Table 4.7.2.3.10–1. Waste Management Cumulative Impacts at Idaho National Engineering Laboratory (2005)—Annual Volumes—Continued

Category	No Action[a] (m^3)	Storage and Disposition[b] (m^3)	Foreign Research Reactor Spent Nuclear Fuel[c] (m^3)	Spent Nuclear Fuel Management[d] (m^3)	Waste Management (m^3)	Total (m^3)
Nonhazardous (Other)						
Liquid	0	Included in sanitary	Included in sanitary	601	68,170[j]	68,800
Solid	Included in sanitary	2,100[k]	NA	NA	NA	2,100

[a] No Action volumes from Table 4.2.3.10–1.

[b] Collocation Alternative.

[c] Alternative announced in Federal Register on May 17, 1996 (61 FR 25092).

[d] Also includes the site-specific environmental restoration and waste management analysis from Volume 2.

[e] Approximately 327 canisters (493 m^3) per year starting 2014.

[f] Represents the estimated TRU waste to be treated to LDR standards at INEL as a result of the TRU Waste Regionalized Alternative 3. The volume was obtained by taking the estimated inventory at INEL and the estimated inventory and 20-year projected generation for the offsite receipts, and dividing by 20 to get an annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 8.1–1, page 8–4).

[g] Represents the estimated LLW to be treated and disposed of at INEL as a result of the LLW Regionalized Alternative 5. The volume was obtained by taking the estimated inventory at INEL and the estimated inventory and 20-year projected generation for the offsite receipts, and dividing by 20 to get an annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 7.1–1, page 7–3).

[h] Represents the estimated mixed LLW to be treated and disposed of at INEL as a result of the Mixed LLW Regionalized Alternative 4. The volume was obtained by taking the estimated inventory at INEL and the estimated inventory and 20-year projected generation for the offsite receipts, and dividing by 20 to get an annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 6.1–1, page 6–3).

[i] Represents the estimated hazardous wastes to be treated at INEL as a result of the hazardous waste Regionalized Alternative 2 (Draft Waste Management PEIS, Vol. I of IV, Table 10.3–7, page 10–20).

[j] Represents the incremental increase of wastewater over No Action all alternatives. Annual volume estimated by assuming 365 days per year (Draft Waste Management PEIS, Vol. II, Tables II-6.4–8 [HLW], page 6–55; II-6.3–11 [TRU], page 6–45; II-6.1–16 [mixed LLW], page 6–19; II-6.2–2 [LLW], page 6–32; and II-6.5–10 [hazardous], page 6–67).

[k] Recyclable wastes.

Note: NA=data was not analyzed in the associated EIS.

Source: 60 FR 28680; 61 FR 9441; 61 FR 25092; DOE 1995cc; DOE 1995dd; DOE 1996g; DOE 1996n; Table 4.2.3.10–1.

4.7.2.4 Pantex Plant

4.7.2.4.1 *Land Resources*

In addition to the storage alternatives, Pantex is being considered as a site for the two other DOE programs identified in Table 4.7.1–1. The total area of undisturbed land that could be affected by these programs during operation 97 ha (241 acres), or 6.5 percent of the government-owned land at Pantex. Site development would be performed in accordance with the land use plans in the *Pantex Site Development Plan*. Long-term storage alternatives which utilize recycled wastewater could require land disturbance and land acquisition for construction of a pipeline. Proposed development would be compatible with the industrial use visual character of the developed areas of Pantex. Cumulatively, the actions would consume land, but would be consistent with the land use plans and visual character of the site.

4.7.2.4.2 *Site Infrastructure*

Some cumulative impacts are possible at Pantex resulting from siting the disposition and storage facilities, and facilities resulting from the other two DOE programs identified in Table 4.7.1–1. The site infrastructure cumulative impacts at Pantex that would result from operation of the proposed projects are shown in Table 4.7.2.4.2–1. Pantex has adequate site availability to meet the requirements for all of the site infrastructure resources except for peak load. Power transmission lines and electrical distribution equipment would be needed to meet the increased power demand.

Table 4.7.2.4.2–1. Site Infrastructure Cumulative Operation Impacts at Pantex Plant

	Electrical		Fuel	
Requirement	**Energy (MWh/yr)**	**Peak Load (MWe)**	**Oil (l/yr)**	**Natural Gas (m3/yr)**
No Action	46,266	10	795,166	7,200,000
Storage and Disposition[a]	58,000	10	38,000	5,200,000
Stockpile Stewardship and Management	0[b]	1[c]	0[b]	0[b]
Waste Management	NA	3.8	NA	NA
Cumulative Requirement	104,266	24.8	833,166	12,400,000
Site Availability	201,480	23	1,775,720	289,000,000

[a] Collocation Alternative.
[b] No Action Alternative.
[c] Downsize Weapons Assembly/Disassembly and High Explosive Fabrication Alternative.
Note: NA=data was not analyzed in the associated EIS.
Source: DOE 1995cc; DOE 1996b; Table 4.2.4.2–1.

4.7.2.4.3 *Air Quality and Noise*

Cumulative impacts to air quality at Pantex include impacts from the No Action Alternative, the two other DOE programs identified in Table 4.7.1–1, and the proposed facilities for each storage alternative. Concentrations are calculated for these emissions and are then compared to Federal and State regulations and guidelines to determine compliance.

Pantex is currently in compliance with the NAAQS as well as State regulations and guidelines. Air emissions attributable to the storage alternatives would increase concentrations of criteria pollutants. Potential cumulative impacts are presented in Table 4.7.2.4.3–1. The resulting concentrations from cumulative impacts would be in compliance with Federal and State regulations.

Table 4.7.2.4.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Pantex Plant and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	No Action (μg/m³)	Other Onsite Activities[b] (μg/m³)	Upgrade Without RFETS or LANL Material (μg/m³)	Consolidation: Construct New and Modify Existing Zone 12 South Facilities (μg/m³)	Consolidation: New Facility (μg/m³)	Collocation (μg/m³)
Criteria Pollutants								
Carbon monoxide	8-hour	10,000[c]	602	17.5	619.5	625.4	625.75	625.4
	1-hour	40,000[c]	2,900	92.8	2,993	3,014	3,015	3,014
Lead	Calendar Quarter	1.5[c]	0.09	[d]	0.09	0.09	0.09	0.09
Nitrogen dioxide	Annual	100[c]	2.15	1.4	3.55	3.69	3.68	3.69
Ozone	1-hour	235[c]	[d]	[e]	[e]	[e]	[e]	[e]
Particulate matter less than or equal to 10 microns in diameter	Annual	50[c]	8.73	0.06	8.79	8.83	8.82	8.83
	24-hour	150[c]	88.5	0.93	89.4	90.1	90.0	90.1
Sulfur dioxide	Annual	80[c]	<0.01	0	<0.01	<0.01	<0.01	<0.01
	24-hour	365[c]	<0.01	0	<0.01	0.05	0.04	0.05
	3-hour	1,300[c]	<0.01	0	<0.01	0.26	0.24	0.26
	30-minute	1,045[e]	<0.01	0	<0.01	0.69	0.65	0.69
Mandated by Texas								
Gaseous fluorides (as HF)	30-day	0.8[f]	<0.75	0	<0.75	<0.75	<0.75	<0.75
	7-day	1.6[f]	<0.75	0	<0.75	<0.75	<0.75	<0.75
	24-hour	2.9[f]	0.75	0	0.75	0.75	0.75	0.75
	12-hour	3.7[f]	1.05	0	1.05	1.05	1.05	1.05
	3-hour	4.9[f]	4.21	0	4.21	4.21	4.21	4.21
Hydrogen sulfide	30-minute	111[f]	[d]	0	[d]	[d]	[d]	[d]
Total suspended particulates	3-hour	200[f]	[g]	0	[d]	3.62[h]	3.23[h]	3.77[h]
	1-hour	400[f]	[g]	0	[d]	9.75[h]	8.71[h]	10.15[h]

Table 4.7.2.4.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Pantex Plant and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	No Action (μg/m³)	Other Onsite Activities[b] (μg/m³)	Upgrade Without RFETS or LANL Material (μg/m³)	Consolidation: Construct New and Modify Existing Zone 12 South Facilities (μg/m³)	Consolidation: New Facility (μg/m³)	Collocation (μg/m³)
Hazardous and Other Toxic Compounds								
Chlorine	Annual	1.5[f]	[d]	0	[d]	<0.01[h]	<0.01[h]	<0.01[h]
	30-minute	15[f]	[d]	0	[d]	0.03[h]	0.03[h]	0.04[h]
Hydrogen chloride	Annual	0.1[f]	0.07	0	0.07	0.07	0.07	0.07
	30-minute	75[f]	6.17	0	6.17	6.18	6.18	6.17
Hydrazine	Annual	0.013[f]	[d]	0	[d]	<0.0001[h]	<0.0001[h]	<0.0001[h]
	30-minute	0.13[f]	[d]	0	[d]	0.01[h]	<0.01[h]	0.01[h]
Nitric acid	Annual	5.2[f]	[d]	0	[d]	<0.01[h]	<0.01[h]	<0.01[h]
	30-minute	52[f]	[d]	0	[d]	0.04[h]	<0.04[h]	0.76[h]
Phosphoric acid	Annual	1[f]	[d]	0	[d]	<0.01[h]	<0.01[h]	<0.01[h]
	30-minute	10[f]	[d]	0	[d]	0.01[h]	0.01[h]	0.01[h]
Sulfuric acid	24-hour	15[f]	[d]	0	[d]	<0.01[h]	<0.01[h]	<0.01[h]
	1-hour	50[f]	[d]	0	[d]	0.01[h]	0.01[h]	0.01[h]

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.
[b] Other onsite activities include those associated with the Stockpile Stewardship and Management and Waste Management programs.
[c] Federal and State standards.
[d] No sources of this pollutant have been identified.
[e] 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 activities.
[f] State standard or guideline.
[g] Data not available from source document.
[h] The concentration represents the alternative contribution and other onsite activities.

Note: 1-hour predicted concentrations were used for 30-minute standard. Concentrations are based on site contribution and do not include the contribution from non-facility sources.

Source: 40 CFR 50; DOE 1995dd; DOE 1996b; PX DOE 1995a:1; PX DOE 1996a; TX NRCC 1992a; Table 4.2.4.3–1.

Cumulative noise impacts include contributions from existing and planned facilities plus proposed storage facilities at the site. Noise impacts may result both from onsite noise sources and from offsite sources such as traffic. Noise impacts on individuals from the storage facilities are expected to be small, resulting in little or no increase in noise levels at offsite areas. Little or no increase in cumulative noise impacts to individuals offsite is expected to occur.

4.7.2.4.4 *Water Resources*

Table 4.7.2.4.4–1 summarizes the estimated cumulative water requirements for the storage alternatives and the two other DOE programs identified in Table 4.7.1–1. Water requirements during the operation of all the proposed projects would be obtained from groundwater resources or if feasible, from the city of Amarillo Hollywood Road Wastewater Treatment Plant. The cumulative water requirements for the site would be a 66-percent increase in the projected No Action usage or approximately 22 percent of the capacity of the groundwater wells at Pantex (1,900 million l/yr [502 million gal/yr]). The total annual site cumulative withdrawal would be approximately 50 percent less than what is currently being withdrawn from the aquifer for use at Pantex (836 million l/yr [221 million gal/yr]). Withdrawing 414 million l/yr (109 million gal/yr) at Pantex would result in drawdowns of approximately 3.9 cm/yr (1.5 in/yr). These additional groundwater withdrawals would add to the existing decline in water levels of the Ogallala Aquifer. To alleviate some of the affects 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 have not been determined.

Table 4.7.2.4.4–2 summarizes the estimated cumulative wastewater discharge to ponds or available for recycling. Total estimated cumulative wastewater discharge (169.2 million l/yr [44.7 million gal/yr]) would be a 20-percent increase in the projected discharge. Existing Pantex treatment facilities could accommodate all the new cumulative process and wastewater streams.

4.7.2.4.5 *Geology and Soils*

Cumulative impacts to geologic and soil resources are expected to be minor as a result of the storage alternatives and the other DOE programs identified in Table 4.7.1–1. A total of 97 ha (241 acres) of the available land at Pantex could be disturbed at the site. Soil erosion and storm water control measures would be used during construction to minimize erosion from the disturbed areas. No valuable geologic resources would be affected by any of the planned programs.

4.7.2.4.6 *Biological Resources*

In addition to ongoing activities and the Storage Alternatives, the Pantex site is being considered for the two other DOE programs identified in Table 4.7.1–1. Some facilities associated with these two programs would largely be within developed areas of the site. Cumulative impacts to terrestrial resources or threatened and endangered species would be minimal. The total area of land used by new facilities would represent about 97 ha (241 acres). Wastewater discharge from the various alternatives could lead to cumulative impacts to site playas. These could include increases in the area of permanent water and possible changes in vegetative composition.

4.7.2.4.7 *Cultural and Paleontological Resources*

The other two DOE programs identified in Table 4.7.1–1 may require ground-disturbing construction, facility modification, and changes in land access and use at Pantex. To date, no known archaeological, Native American, or paleontological resources exist within the areas selected for construction at Pantex, but some of the areas have not been systematically surveyed. Prior to construction activity, specific surveys, evaluations, and Native American consultations would be conducted pursuant to NHPA, the *American Indian Religious Freedom Act*, and the *Native American Graves Protection and Repatriation Act*. Cumulative impacts resulting from the storage alternatives, if any, are expected to be minimal.

Table 4.7.2.4.4–1. Cumulative Annual Water Usage at Pantex Plant

Program	Water Requirements (million l/yr)
No Action	249
Storage and Disposition	130[a,b]
Stockpile Stewardship and Management	0[c]
Waste Management	35[a]
Total annual cumulative water usage	414

[a] Data represents the maximum value for the comparative scenario.
[b] Data represents the Collocation Alternative.
[c] No additional water usage would result from this program.
Source: DOE 1995dd; DOE 1996b; PX 1995a:1; Table 4.2.4.4–1.

Table 4.7.2.4.4–2. Cumulative Annual Wastewater Discharge at Pantex Plant

Program	Nonhazardous Sanitary and Industrial Wastewater (million l/yr)
No Action	141
Storage and Disposition	12.2[a,b]
Stockpile Stewardship and Management	0[c]
Waste Management	16[a]
Total annual cumulative water usage	169.2

[a] Data represents the maximum value for the comparative scenario.
[b] Data represents the Collocation Alternative.
[c] No additional wastewater discharge would result from this program.
Source: DOE 1995dd; DOE 1996b; PX 1995a:1; PX MH 1994a; Table 4.2.4.4–1.

[Text deleted.]

4.7.2.4.8 *Socioeconomics*

Cumulative impacts on Pantex's regional economy, population, housing, community services and local transportation would be minor. As shown in Table 4.7.2.4.8–1, the regional economy would improve without any burden on the housing market. The cumulative impact shown in Table 4.7.2.4.8–1 would be minor because of the relatively small size of the programs.

Table 4.7.2.4.8–1. Socioeconomic Cumulative Impacts at Pantex Plant

Program	Direct Employment[a]
Storage and Disposition[b]	1,176
Stockpile Stewardship and Management	280
Waste Management	654
Total	2,110

[a] Operations.
[b] Collocation Alternative.
Source: DOE 1995cc; DOE 1996b; Section 4.2.4.8.

4.7.2.4.9 *Public and Occupational Health and Safety*

Radiological Impacts. The maximum incremental radiological doses and resulting health effects for the storage alternative, the No Action Alternative, and other actions planned at Pantex, are presented in Table 4.7.2.4.9–1. Although these impacts could be added, it should be noted that the exact locations of the facilities for planned actions may change. In addition, because each of these facilities is sited in a different location, the location of the MEI for each is also different. The MEIs have been selected to maximize the potential dose for a given facility. Since the MEI would have to be resident at more than one location simultaneously in order to receive the maximum dose from each facility, summing the doses would be misleading. The offsite population and total site workforce doses have not been summed because the population distribution and workforce totals as analyzed vary among the actions. [Text deleted.]

Chemical Impacts. For Pantex, the various NEPA documents use different but otherwise acceptable methodologies to assess the health effects from hazardous chemical exposure for proposed activities. These methodologies may have different indicators for determining the health impact (for example, hazard index, cancer risk, or chemical concentration in the environment). These different indicators prevent a uniform quantitative cumulative impact analysis for this site. However, as indicated in the health impact analysis sections in the NEPA documents for the proposed actions, the health effect from any proposed action at Pantex is predicted to contribute only slightly to the impacts from the baseline activity (No Action). The potential cumulative health impact from hazardous chemicals from implementation of the proposed activities would not exhibit a noticeable increase above the baseline, would be expected to fall within acceptable regulatory limits.

*Table 4.7.2.4.9–1. **Estimated Average Annual Cumulative Radiological Doses and Resulting Health Effects to the Public and Workers From Normal Operation at Pantex Plant***

	Maximally Exposed Individual Member of the Public		Offsite Population Within 80 km		Total Site Workforce	
Program	**Total Dose (mrem)**	**Fatal Cancer Risk**	**Total Dose (person-rem)**	**Number of Fatal Cancers**	**Total Dose (person-rem)**	**Number of Fatal Cancers**
No Action	6.1×10^{-5}	3.1×10^{-11}	2.8×10^{-4}	1.4×10^{-7}	14	5.6×10^{-3}
Storage and Disposition[a]	9.6×10^{-6}	4.8×10^{-12}	5.3×10^{-5}	2.9×10^{-8}	25	0.010
Stockpile Stewardship and Management	4.0×10^{-5}	2.0×10^{-11}	4.0×10^{-4}	2.0×10^{-7}	-7.7	-3.1×10^{-3}
Waste Management	5.9×10^{-4}	2.9×10^{-10}	6.9×10^{-3}	3.5×10^{-6}	6.9×10^{-4}	2.8×10^{-7}

[a] The impacts from the collocation storage facility are presented since they encompass both Pu and HEU storage.
Source: DOE 1995cc; DOE 1995dd; DOE 1996b; Tables 4.2.4.9–1 and 4.2.4.9–2.

4.7.2.4.10 *Waste Management*

In addition to the storage alternatives, the other DOE programs listed in Table 4.7.1–1 would contribute to cumulative impacts at Pantex as shown in Table 4.7.2.4.10–1. The largest impact on waste management would result if the LLW Regionalized Alternative 2 and the mixed LLW Regionalized Alternative 1 were selected as the preferred alternative in the Waste Management PEIS. The Collocation Storage Alternative from this PEIS would contribute the next largest impact on waste management at Pantex.

Table 4.7.2.4.10–1. Waste Management Cumulative Impacts at Pantex Plant (2005)—Annual Volumes

Category	No Action[a] (m^3)	Storage and Disposition PEIS[b] (m^3)	Stockpile Stewardship and Management PEIS (m^3)	Waste Management PEIS (m^3)	Total (m^3)
Transuranic					
Liquid	None	0.02	0[c]	0	0.02
Solid	None	10	0[c]	0	10
Mixed Transuranic					
Liquid	None	0	0[c]	0	0
Solid	None	4	0[c]	0	4
Low-Level					
Liquid	8	2.1	0[c]	Included in solid	10
Solid	32	1,300	0[c]	1,700[d]	3,032
Mixed Low-Level					
Liquid	4	0.2	0[c]	Included in solid	4
Solid	46	66	0[c]	7[e]	119
Hazardous					
Liquid	2	2	0[c]	0	4
Solid	31	2	0[c]	0[f]	33
Nonhazardous (Sanitary)					
Liquid	141,000	129,500	7,060[g]	NA	277,600
Solid	339	1,840	18[g]	NA	2,197

Table 4.7.2.4.10–1. Waste Management Cumulative Impacts at Pantex Plant (2005)—Annual Volumes—Continued

Category	No Action[a] (m³)	Storage and Disposition PEIS[b] (m³)	Stockpile Stewardship and Management PEIS (m³)	Waste Management PEIS (m³)	Total (m³)
Nonhazardous (Other)					
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	12,700[h]	12,700
Solid	Included in sanitary	2,300[i]	Included in sanitary	Included in sanitary	2,300

[a] No Action volumes are from Table 4.2.4.10–1.
[b] Collocation Storage Alternative (New Pu and HEU Storage Facility).
[c] No Action Alternative.
[d] Represents LLW Regionalized Alternative 2 in which Pantex would treat and dispose of its own LLW onsite. The volume was obtained by taking the estimated inventory and dividing by 20 to get annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 7.1–1, page 7–3).
[e] Represents mixed LLW Decentralized Alternative or Regionalized Alternative 1. Pantex would treat and dispose of its own mixed LLW onsite. The volume was obtained by taking the estimated inventory and dividing by 20 to get annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 6.1–1, page 6–3).
[f] No Action or Decentralized Alternative.
[g] Downsize Assembly/Disassembly and HE fabrication alternative.
[h] Represents the total annual incremental wastewater over No Action for all alternatives. Annual volume estimated by assuming 365 days per year (Draft Waste Management PEIS, Vol. II. Tables II-12.1–14 [mixed LLW], page 12–15; and II-12.2–12 [LLW], page 12–29).
[i] Recyclable wastes.
Source: DOE 1995cc; DOE 1995dd; DOE 1996b; PX 1995a:2, PX DOE 1995e; Table 4.2.4.10–1.

4.7.2.5 Oak Ridge Reservation

4.7.2.5.1 *Land Resources*

ORR is a potential site for the storage alternatives and for the three other DOE programs identified in Table 4.7.1–1. The total area of undisturbed land that could be affected by these programs during operation is 154 ha (382 acres), or less than 1 percent of the total land at ORR. Cumulative impacts are possible to NERP lands at ORR due to encroachment of the new development projects. A portion of the consolidated storage facility could be constructed on land designated for waste management in the *ORR Site Development and Facilities Utilization Plan*. Proposed development could affect visual resources near Route 95 and Bear Creek Road by changing the current VRM class 4 to a class 5.

4.7.2.5.2 *Site Infrastructure*

Some cumulative impacts are possible at ORR resulting from implementation of the storage alternatives, ongoing activities, and the three other DOE programs identified in Table 4.7.1–1. In addition, environmental restoration activities at ORR are expected to continue for 30 years and therefore will coincide with the construction and operation of the proposed disposition facilities as well as many of the other DOE programs. Table 4.7.2.5.2–1 shows the site infrastructure cumulative impacts that would result from operation of the proposed programs were they to be sited at ORR. The cumulative requirements for oil and coal exceed the ORR site availability. Oil storage tanks and coal handling facilities would need to be constructed to meet the new resource requirements.

Table 4.7.2.5.2–1. Site Infrastructure Cumulative Operation Impacts at Oak Ridge Reservation

	Electrical		Fuel		
Requirement	**Energy (MWh/yr)**	**Peak Load (MWe)**	**Oil (l/yr)**	**Natural Gas (m^3/yr)**	**Coal (t/yr)**
No Action	726,000	110	379,000	95,000,000	16,300
Storage and Disposition	60,260[a]	10[a]	50,000[b]	949[a]	5,973[b]
HEU Disposition	5,000	2	56,800	0	363
Stockpile Stewardship and Management[c]	0	0	0	0	0
Waste Management	NA	88.6	NA	NA	NA
Cumulative Requirement	791,260	210.6	485,800	95,000,949	22,636
Site Availability	13,880,000	2,100	416,000	250,760,000	16,300

[a] Collocation Alternative (New Pu Storage Facility and Modify Y–12).
[b] Collocation Alternative (New Pu and HEU Storage Facilities).
[c] No Action data is used because the rest of the alternatives in the Stockpile Stewardship and Management PEIS would result in downsizing.
Note: NA=data was not analyzed in the associated EIS.
Source: DOE 1995cc; DOE 1996b; DOE 1996m; Table 4.2.5.2–1.

4.7.2.5.3 *Air Quality and Noise*

Cumulative impacts to air quality at ORR include impacts from No Action Alternative, the three other DOE programs identified in Table 4.7.1–1, and the proposed facilities for each storage alternative. Concentrations are calculated for these emissions and are then compared to Federal and State regulations and guidelines to determine compliance.

The ORR is currently in compliance with the NAAQS as well as state regulations and guidelines. Air emissions attributable to the storage alternatives would increase concentrations of criteria pollutants. Potential cumulative impacts are presented in Table 4.7.2.5.3–1. The resulting concentrations from cumulative impacts would be in compliance with Federal and State regulations.

Cumulative noise impacts include contributions from existing and planned facilities plus proposed storage facilities at the site. Noise impacts may result both from onsite noise sources and from offsite sources such as traffic. Noise impacts on individuals from the storage facilities are expected to be small, resulting in little or no increase in noise levels at offsite areas. Little or no increase in cumulative noise impacts to individuals offsite is expected to occur.

4.7.2.5.4 *Water Resources*

Table 4.7.2.5.4–1 summarizes the estimated cumulative water requirements for the storage alternatives and the three other DOE programs identified in Table 4.7.1–1. Water requirements during the operation of all the proposed projects would be obtained from the Clinch River. The cumulative water requirements for the site would be 0.3 percent of the Clinch River's average flow (135 m^3/s [4,763 ft^3/s]). The Collocation Alternative would account for approximately 2.4 percent of the cumulative usage. The additional withdrawals are minor in comparison to the average flow of the river and would not noticeably affect the local or regional water supply.

Table 4.7.2.5.4–1. Cumulative Annual Water Usage at Oak Ridge Reservation

Program	Water Requirements (million l/yr)
No Action	14,760[a]
Storage and Disposition	360[b]
HEU Disposition	19[c,d]
Stockpile Stewardship and Management	0[e]
Waste Management	814.5[c]
Total annual cumulative water usage	15,954

[a] Data include both groundwater and surface water.
[b] Number is based on the Collocation Alternative.
[c] Data represents the maximum value for the comparative alternative scenario.
[d] Based on preliminary data.
[e] The Stockpile Stewardship and Management alternatives would require no additional water.
Source: DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996m; Table 4.2.5.4–1.

Table 4.7.2.5.4–2 summarizes the estimated cumulative water discharge to the Clinch River via Bear Creek, McCoy Branch, Rogers Quarry, and East Fork Poplar Creek. The cumulative wastewater discharge would be a 75-percent increase in the average Bear Creek flow near Y–12 (0.11 m^3/s [3.9 ft^3/s]), 5.5 percent of the average flow at East Fork Poplar Creek (1.5 m^3/s [53 ft^3/s]) and 0.06 percent of the average flow of the Clinch River (132 m^3/s [4,647 ft^3/s]). The Collocation Alternative would account for 7 percent of the total annual cumulative wastewater discharge. The expected total cumulative wastewater discharge to the tributaries would continue to meet limits and reporting requirements. Existing ORR treatment facilities could accommodate all the new cumulative process and wastewater streams.

[Text deleted.]

4.7.2.5.5 *Geology and Soils*

Cumulative impacts to geologic and soil resources are expected to be minor as a result of the storage alternatives and the other DOE programs identified in Table 4.7.1–1. A total of 154 ha (382 acres) could be disturbed at the

Table 4.7.2.5.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Oak Ridge Reservation and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	No Action (μg/m³)	Other Onsite Activities[b] (μg/m³)	Upgrade (μg/m³)	Collocation: New Pu Storage Facility Only (μg/m³)	Collocation: New Pu Storage Facility and Modify Y–12 (μg/m³)	Collocation: New Pu and HEU Storage Facilities (μg/m³)
Criteria Pollutants								
Carbon monoxide	8-hour	10,000[c]	5	11.5	16.5	16.58	16.57	16.59
	1-hour	40,000[c]	11	62.4	73.4	73.56	73.55	73.58
Lead	Calendar Quarter	1.5[c]	0.05	<0.01	<0.06	<0.06	<0.06	<0.06
Nitrogen dioxide	Annual	100[c]	3	1.93	4.93	4.93	4.99	5.0
Ozone	1-hour	235[c]	d	d	d	d	d	d
Particulate matter less than or equal to 10 microns in diameter	Annual	50[c]	1	10.03	11.03	11.03	11.03	11.04
	24-hour	150[c]	2	30.37	32.37	32.42	32.42	32.42
Sulfur dioxide	Annual	80[c]	2	48.11	50.11	50.21	50.21	50.23
	24-hour	365[c]	32	237.5	269.5	270.6	270.5	270.8
	3-hour	1,300[c]	80	902	982	986.2	986.0	986.9
Mandated by Tennessee								
Total suspended particulates	24-hour	150[e]	2	80.16	82.16	82.21	82.20	82.21
Gaseous fluorides (as HF)	30-day	1.2[e]	0.2	0	0.2	0.2	0.2	0.2
	7-day	1.6[e]	0.3	0	0.3	0.3	0.3	0.3
	24-hour	2.9[e]	0.6[f]	0	0.6[f]	0.6[f]	0.6[f]	0.6[f]
	12-hour	3.7[e]	0.6[f]	0	0.6[f]	0.6[f]	0.6[f]	0.6[f]
	8-hour	250[e]	0.6	0	0.6	0.6	0.6	0.6

Table 4.7.2.5.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Oak Ridge Reservation and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	No Action (μg/m³)	Other Onsite Activities[b] (μg/m³)	Upgrade (μg/m³)	Collocation: New Pu Storage Facility Only (μg/m³)	Collocation: New Pu Storage Facility and Modify Y–12 (μg/m³)	Collocation: New Pu and HEU Storage Facilities (μg/m³)
Hazardous and Other Toxic Compounds								
Chlorine	8-hour	150[e]	4.1	0	4.1	4.1	4.1	4.1
Hydrogen chloride	8-hour	750[e]	57	0	57	57	57	57
Hydrazine	8-hour	1.3[e]	[g]	0	[g]	[g]	[g]	<0.01[h]
Mercury	8-hour	5[e]	0.06[i]	0	0.06[i]	0.06[i]	0.06[i]	0.06[i]
Nitric acid	8-hour	[j]	78	0	78	78	78	78
Phosphoric acid	8-hour	[j]	[g]	0	[g]	[g]	[g]	<0.01[h]
Sulfuric acid	8-hour	[j]	20	0	20	20	20	20

[a] The more stringent of the Federal and State standard is presented if both exist for the averaging time.
[b] Other onsite activities include those associated with HEU Disposition, Stockpile Stewardship and Management, and Waste Management programs.
[c] Federal and State standard.
[d] 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.
[e] State standard or guideline.
[f] 8-hour concentration was used.
[g] No sources of this pollutant have been identified.
[h] The concentration represents the alternative contribution and other onsite activities.
[i] Annual average (monitored value).
[j] No State standard for indicated averaging time.
Note: Concentrations are based on site contribution and do not include the contribution from non-facility sources.
Source: 40 CFR 50; DOE 1995w; DOE 1995dd; DOE 1996b; DOE 1996m; OR DOE 1993a; OR LMES 1996i; OR MMES 1996a; TN DEC 1994a; TN DHE 1991a; Table 4.2.5.3–1.

Table 4.7.2.5.4–2. Cumulative Annual Wastewater Discharge at Oak Ridge Reservation

Program	Nonhazardous Sanitary and Industrial Wastewater (million l/yr)
No Action	2,277[a]
Storage and Disposition	172[b,c]
HEU Disposition	18.7[b]
Stockpile Stewardship and Management	0[d]
Waste Management	101.9[b]
Total annual cumulative wastewater	2,569.6

[a] These data include nonhazardous sanitary and nonhazardous wastewater discharges.

[b] Data are based on the highest treated volumes from the alternatives scenario.

[Text deleted.]

[c] Number is based on the Collocation Alternative.

[d] The Stockpile Stewardship and Management alternatives at ORR include the downsizing or the phaseout of the secondary and fabrication mission. No additional wastewater discharge is to be expected.

Source: DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996m; Table 4.2.5.4–1.

site. Soil erosion and storm water control measures would be used during construction to minimize erosion from the disturbed areas. No valuable geologic resources would be affected by any of the planned programs.

4.7.2.5.6 *Biological Resources*

In addition to ongoing activities and the Storage Alternatives, ORR is being considered for the three other DOE programs identified in Table 4.7.1–1. While some of these programs would be located within existing structures or developed areas of ORR, others would be constructed at undisturbed sites. The total area of undeveloped land would be 154 ha (382 acres), or about 1 percent of the total ORR area. Discharges from the proposed facilities would be directed to Bear Creek, East Fork Popular Creek, and the Clinch River, thus increasing the possibility of cumulative impacts to wetlands and aquatic resources associated with these water bodies. Cumulative impacts to Bear Creek could also increase the potential to affect the Tennessee dace (State-deemed in need of management). The cumulative loss of habitat could lead to additional impacts to special status species compared to those resulting from construction of a storage facility along; however, their status on ORR would not be expected to be jeopardized. Species that could be affected include a number of State-protected plant species such as the pink lady's-slippers, fen orchid, tubercled rein-orchid, American ginseng, purple fringeless orchid, Canada lily, and golden seal.

4.7.2.5.7 *Cultural and Paleontological Resources*

The three other DOE programs identified in Table 4.7.1–1 may require ground-disturbing construction, facility modification, and changes in land access and use at ORR. New construction is proposed for currently undeveloped land within ORR. Some of the undeveloped land has been surveyed. Archaeological sites have been identified on this land and they could be affected by proposed disposition alternatives. [Text deleted.] Prior to construction activity, specific surveys, evaluations, and Native American consultations would be conducted pursuant to NHPA, the *American Indian Religious Freedom Act*, and the *Native American Graves Protection and Repatriation Act*.

New construction and building modification would also occur within Y–12 under several DOE programs. This area is unlikely to contain archaeological, Native American, and paleontological resources because it is developed and disturbed. Y–12 does, however, contain a proposed historic district and many of the facilities are potentially NRHP-eligible. Extensive building modification and new facility construction could compromise the historic integrity of the area. Work would be done in consultation with the Tennessee SHPO and the Advisory Council on Historic Preservation. Cumulative impacts to cultural resources are possible at ORR because it contains known NRHP-eligible facilities that may be impacted by the storage alternatives as well as other reasonably foreseeable future actions.

4.7.2.5.8 *Socioeconomics*

Cumulative impacts on ORR's regional economy, population, housing, community services, and local transportation would be minor. Generally, the regional economy would improve without burdening the housing market, but new traffic could cause congestion on local roads. Because each of the other three DOE programs identified in Table 4.7.2.5.8–1 is relatively small, their cumulative socioeconomic impact is expected to be minor. The primary impact will be to stimulate regional economic growth. If all of these programs were located at ORR, transportation congestion and the demand for new housing and other public services could increase. However, housing construction trends indicate that this additional population could be accommodated without significant impacts to the housing industry.

Table 4.7.2.5.8–1. Socioeconomic Cumulative Impacts at Oak Ridge Reservation

Program	Direct Employment[a]
Storage and Disposition[b]	566
HEU Disposition	125
Stockpile Stewardship and Management	-805
Waste Management	3,581
Total	3,467

[a] Operations.
[b] Collocation Alternative.
Source: DOE 1995cc; DOE 1996b; DOE 1996m; Section 4.2.5.8.

4.7.2.5.9 *Public and Occupational Health and Safety*

Radiological Impacts. The maximum incremental radiological doses and resulting health effects for the storage alternative, the No Action Alternative, and other actions planned at ORR, are presented in Table 4.7.2.5.9–1. Although these impacts could be added, it should be noted that the exact locations of the facilities for planned actions may change. In addition, because each of these facilities is sited in a different location, the location of the MEI for each is also different. The MEIs have been selected to maximize the potential dose for a given facility. Since the MEI would have to be resident at more than one location simultaneously in order to receive the maximum dose from each facility, summing the doses would be misleading. The offsite population and total site workforce doses have not been summed because the population distribution and workforce totals as analyzed vary among the actions. [Text deleted.]

Chemical Impacts. For ORR, the various NEPA documents use different but otherwise acceptable methodologies to assess the health effects from hazardous chemical exposure for proposed activities. These methodologies may have different indicators for determining the health impact (for example, hazard index, cancer risk, or chemical concentration in the environment). These different indicators prevent a uniform quantitative cumulative impact analysis for this site. However, as indicated in the health impact analysis sections in the NEPA documents for the proposed actions, the health effect from any proposed action at ORR is predicted to contribute only slightly to the impacts from the baseline activity (No Action). The potential cumulative health impact from hazardous chemicals from implementation of the proposed activities would not exhibit a noticeable increase above the baseline, would be expected to fall within acceptable regulatory limits.

Table 4.7.2.5.9–1. Estimated Average Annual Cumulative Radiological Doses and Resulting Health Effects to the Public and Workers From Normal Operation at Oak Ridge Reservation

Program	Maximally Exposed Individual Member of the Public		Offsite Population Within 80 km		Workers	
	Total Dose (mrem)	Fatal Cancer Risk	Total Dose (person-rem)	Number of Fatal Cancers	Total Dose (person-rem)	Number of Fatal Cancers
No Action	3.2	1.6×10^{-6}	34	0.017	44	0.018
Storage and Disposition[a]	4.5×10^{-5}	2.3×10^{-11}	8.7×10^{-4}	4.4×10^{-7}	25	0.010
HEU Disposition	3.9×10^{-2}	2.0×10^{-8}	0.16	8.0×10^{-5}	11.3	4.5×10^{-3}
Stockpile Stewardship and Management	0.20	1.0×10^{-7}	0.60	3.0×10^{-4}	-1.8	-7.2×10^{-4}
[Text deleted.]						
Waste Management	0.58	2.9×10^{-7}	19	9.4×10^{-3}	0.45	1.8×10^{-4}

[a] The impacts from the collocation storage facility are presented since they encompass both Pu and HEU storage.
Source: DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996m; Tables 4.2.5.9–1 and 4.2.5.9–2.

4.7.2.5.10 *Waste Management*

Cumulative impacts to waste management at ORR could arise from the activities associated with ongoing activities, the storage alternatives, and the other three DOE programs identified in Table 4.7.1–1. Table 4.7.2.5.10–1 summarizes the estimated cumulative waste amounts. The largest cumulative impacts at ORR resulting from DOE's Waste Management Program would be if ORR were selected as a regional treatment and disposal site for LLW and a regional treatment and disposal site for mixed LLW. It is expected that waste management activities associated with the storage of Pu and HEU would have consistently smaller impacts than any future environmental restoration and waste management activities at ORR, and that the overall impact of Pu and HEU storage would not contribute significantly to cumulative impacts, except for TRU waste.

As part of the Stockpile Stewardship and Management PEIS, a downsize and consolidation alternative for the secondary fabrication mission is being considered. This alternative would decrease the generation of all categories of waste at ORR; therefore, the No Action Alternative would have the greatest negative impact on waste management at ORR.

Table 4.7.2.5.10–1. Waste Management Cumulative Impacts at Oak Ridge Reservation (2005)—Annual Volumes

Category	No Action[a] (m^3)	Storage and Disposition (m^3)	HEU Disposition (m^3)	Stockpile Stewardship and Management[b] (m^3)	Waste Management (m^3)	Total (m^3)
Spent Fuel	0	0	0	0	0	0
High Level						
Liquid	0	0	0	0	0	0
Solid	0	0	0	0	0	0
Transuranic						
Liquid	0	0.02[c]	0	0	Included in solid	0.02
Solid	119	10[c]	0	0	99[d]	227
Mixed Transuranic						
Liquid	0	0[c]	0	0	Included in TRU	0
Solid	0	4[c]	0	0	Included in TRU	4
Low-Level						
Liquid	2,970	2[e]	280[f]	0	Included in solid	3,250
Solid	7,320	1,300[c]	545[f]	0	16,200[g]	25,400
Mixed Low-Level						
Liquid	87,600	0.2[e]	46[h]	0	Included in solid	87,700
Solid	432	66[e]	0	0	3,540[i]	4,040
Hazardous						
Liquid	6,460	2[c]	88[h]	0	Included in solid	6,550
Solid	26	2[c]	0	0	1,120[j]	1,150
Nonhazardous (Sanitary)						
Liquid	550,000	171,840[c]	18,000[h]	0	NA	739,000
Solid	53,100	1,720[c]	410[h]	0	NA	55,200

Table 4.7.2.5.10–1. Waste Management Cumulative Impacts at Oak Ridge Reservation (2005)—Annual Volumes—Continued

Category	No Action[a] (m³)	Storage and Disposition (m³)	HEU Disposition (m³)	Stockpile Stewardship and Management[b] (m³)	Waste Management (m³)	Total (m³)
Nonhazardous (Other)						
Liquid	650,000	0.8[g]	773[h]	0	64,800[k]	716,000
Solid	321	2,200[c]	410[g,h]	0	NA	2,930

[a] No Action volumes are from Table 4.2.5.10–1.

[b] No Action Alternative.

[c] Collocation Alternative (New Pu and HEU Storage Facility).

[d] Represents TRU Waste Decentralized Alternative in which ORR would treat its own newly generated and existing inventory of TRU waste. The volume was obtained by taking the current inventory divided by 20 to get annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 8.1–1, page 8–4).

[e] Collocation Alternative (New Pu Storage Facility and Upgrade Y-12).

[f] Represents blending HEU to LEU as metal.

[g] Represents LLW Regionalized Alternative 5 in which ORR would treat and dispose of onsite and offsite LLW. The volume was obtained by taking the estimated inventory at ORR plus the inventory and 20-year generation projection for offsite receipts and dividing by 20 to get annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 7.1–1, page 7–3).

[h] Represents blending HEU to 4 percent LEU as UNH.

[i] Represents mixed LLW Regionalized Alternative 4 in which ORR would treat and dispose of onsite and offsite mixed LLW. The volume was obtained by taking the estimated inventory at ORR plus the estimated inventory and 20-year generation for offsite receipts and dividing by 20 to get annual estimate (Draft Waste Management PEI Vol. I of IV, Table 6.1–1, page 6–3).

[j] Represents the estimated hazardous waste to be treated at ORR as a result of hazardous waste Regionalized Alternative 2 (Draft Waste Management PEIS, Vol. I of IV, Table 10.3–7, page 10–20).

[k] Represents the total incremental annual wastewater over No Action for all alternatives. Annual volume was obtained by assuming 365 days per year (Draft Waste Management PEIS, Vol. II, Tables II-10.3–11 [TRU], page 10–45; II-10.1–15 [mixed LLW], page 10–17; II-10.2–12 [LLW]. page 10–33; and II-10.5–10 [hazardous], page 10–58).

Note: NA=data was not analyzed in the associated PEIS.

Source: DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996m; Table 4.2.5.10–1.

4.7.2.6 Savannah River Site

4.7.2.6.1 *Land Resources*

In addition to the storage alternatives, SRS is being considered as a site for the six other DOE programs identified in Table 4.7.1–1. The total area of undisturbed land that could be affected by these programs during operation is 223 ha (550 acres), or less than 0.3 percent of the total land at SRS. Site development would be performed in accordance with the land-use plans in the SRS Site Development Plan. Proposed development would also be compatible with the industrial use visual character of the developed areas of SRS. Cumulatively, the actions would consume land but would be consistent with the land use plans and visual character of the site.

4.7.2.6.2 *Site Infrastructure*

Some cumulative impacts are possible at SRS resulting from implementation of the storage alternatives and the other six DOE programs identified in Table 4.7.1–1. The site infrastructure cumulative impacts that would result at SRS from operation of all of the proposed alternatives are shown in Table 4.7.2.6.2–1. The cumulative requirements for energy, peak load, oil, and coal would exceed the site availability at SRS. Transmission lines, electrical distribution equipment, and oil storage tanks would need to be constructed to satisfy the new resource requirements. Additional coal requirements would be satisfied using existing procurement practices.

Table 4.7.2.6.2–1. Site Infrastructure Cumulative Operation Impacts at Savannah River Site

	Electrical		Fuel	
Requirement	Energy (MWh/yr)	Peak Load (MWe)	Oil (l/yr)	Coal (t)
No Action	794,000	116	28,390,500	221,352
Storage and Disposition[a]	76,000	13	47,000	4,800
Foreign Research Reactor Spent Nuclear Fuel	1,500	NA	NA	NA
HEU Disposition	5,000	NA	56,800	360
Spent Nuclear Fuel	24,400	NA	0	0
Stockpile Stewardship and Management	9,700	1.6	28,400	1,090
Tritium Supply/Recycling	3,740,000	550	13,200	0
Waste Management	NA	13.7	NA	NA
Cumulative Requirement	4,790,600	694.3	32,135,900	227,602
Site Availability	1,672,000	330	28,390,500	221,352

[a] Collocation Alternative.

Note: NA=data was not analyzed in the associated EIS.

Source: DOE 1995i; DOE 1995p; DOE 1995cc; DOE 1996b; DOE 1996g; DOE 1996m; Table 4.2.6.2–1.

4.7.2.6.3 *Air Quality and Noise*

Cumulative impacts to air quality at SRS include impacts from the No Action Alternative, the other seven DOE programs identified in Table 4.7.1–1, and the proposed facilities for each alternative. Concentrations are calculated for these emissions and are then compared to Federal and State regulations and guidelines to determine compliance.

The SRS is currently in compliance with the NAAQS as well as State regulations and guidelines. Air emissions attributable to the storage alternatives would increase concentrations of criteria pollutants. Potential cumulative impacts are presented in Table 4.7.2.6.3–1. The resulting concentrations from cumulative impacts would be in compliance with Federal and State regulations.

Table 4.7.2.6.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Savannah River Site and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	No Action (μg/m³)	Other Onsite Activities[b] (μg/m³)	Upgrade[c] (μg/m³)	Consolidation (μg/m³)	Collocation (μg/m³)
Criteria Pollutants							
Carbon monoxide	8-hour	10,000[d]	22	41.88	64.05	66.03	66.28
	1-hour	40,000[d]	171	107.1	278.9	288.2	289.4
Lead	Calendar Quarter	1.5[d]	0.0004	0.00003	0.00043	0.00043	0.00043
Nitrogen dioxide	Annual	100[d]	5.7	3.53	9.33	10.15	10.31
Ozone	1-hour	235[d]	e	e	e	e	e
Particulate matter less than or equal to 10 microns in diameter	Annual	50[d]	3	1.125	4.135	4.185	4.195
	24-hour	150[d]	50.6	5.68	56.43	57.51	57.72
Sulfur dioxide	Annual	80[d]	14.5	0.386	15.18	16.34	16.67
	24-hour	365[d]	196	19.09	220.7	243.1	249.6
	3-hour	1,300[d]	823	112.2	971.9	1116	1158
Mandated by South Carolina							
Total suspended particulates (TSP)	Annual	75[f]	12.6	2.065	14.68	14.73	14.74
Gaseous fluorides (as HF)	30-day	0.8[f]	0.09	0.019	0.109	0.109	0.109
	7-day	1.6[f]	0.39	0.067	0.457	0.457	0.457
	24-hour	2.9[f]	1.04	0.175	1.215	1.215	1.215
	12-hour	3.7[f]	1.99	0.327	2.317	2.317	2.317

Table 4.7.2.6.3–1. Estimated Cumulative Operational Concentrations of Pollutants at Savannah River Site and Comparison With Most Stringent Regulations or Guidelines—No Action and Storage Alternatives—Continued

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines[a] (μg/m³)	No Action (μg/m³)	Other Onsite Activities[b] (μg/m³)	Upgrade[c] (μg/m³)	Consolidation (μg/m³)	Collocation (μg/m³)
Hazardous and Other Toxic Compounds							
Benzene	24-hour	150[d]	31.71	0.001	31.71	31.71	31.71
Chlorine	24-hour	75[f]	7.63	0	7.63	7.63[g]	7.63
Hydrogen chloride	24-hour	175[f]	[h]	0	[h]	<0.01[g]	<0.01[g]
Hydrazine	24-hour	0.5[f]	[h]	0	[h]	<0.01[g]	<0.01[g]
Nitric acid	24-hour	125[f]	50.96	4.76	55.72	55.72	55.77
Phosphoric acid	24-hour	25[f]	0.462	0	0.462	0.462	0.462
Sulfuric acid	24-hour	10[f]	[h]	0	[h]	<0.01[g]	<0.01[g]

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

[b] Other onsite activities include those associated with the Foreign Research Reactor Spent Nuclear Fuel, HEU Disposition, Interim Management of Nuclear Materials, Spent Nuclear Fuel Management, Stockpile Stewardship and Management, Tritium Supply/Recycling, and Waste Management Programs.

[c] Applies to the New F-Area Facility option.

[d] Federal and State standards.

[e] 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.

[f] State standard or guideline.

[g] The concentration represents the alternative contribution and other onsite activities.

[h] No sources of this pollutant have been identified.

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

Source: 40 CFR 50; DOE 1995p; DOE 1996b; DOE 1996g; SC DHEC 1991a; SC DHEC 1992b; SR DOE 1994a; SR DOE 1994e; SR DOE 1995b; SR DOE 1995e; WSRC 1994e; Table 4.2.6.3–1.

Cumulative noise impacts include contributions from existing and planned facilities plus proposed storage facilities at the site. Noise impacts may result both from onsite noise sources and from offsite sources, such as traffic. Noise impacts on individuals from the storage facilities are expected to be small, resulting in little or no increase in noise levels at offsite areas. Little or no increase in cumulative noise impacts to individuals offsite is expected to occur.

4.7.2.6.4 *Water Resources*

Table 4.7.2.6.4–1 summarizes the estimated cumulative annual water requirements for the storage alternatives and the six other DOE programs identified in Table 4.7.1–1. Water requirements during operation of all the proposed projects would be obtained from existing or new well fields at SRS and from the Savannah River. The cumulative water requirements for the site would be a 4-percent increase over projected No Action water usage. Suitable groundwater from the deep aquifers at the site is abundant and aquifer depletion is not a problem. The proposed Collocation Alternative would account for 0.3 percent of the total cumulative water usage.

Table 4.7.2.6.4–2 summarizes the estimated treated wastewater discharge to the Savannah River. The cumulative wastewater discharge to the river would be 0.02 percent of the average Savannah River flow (283 m^3/s [9,994 ft^3/s]), and 0.04 percent of the Savannah River minimum flow (152 m^3/s [5,368 ft^3/s]). The proposed Collocation Alternative would account for approximately 17 percent of the total annual cumulative wastewater discharge. The expected total cumulative wastewater discharge to the tributaries would continue to meet NPDES limits and reporting requirements. Existing SRS treatment facilities could accommodate all the new cumulative processes and wastewater streams if a new facility is built for tritium supply and recycling operations as planned.

[Text deleted.]

Table 4.7.2.6.4–1. Cumulative Annual Water Usage at Savannah River Site

Program	Water Requirement (million l/yr)
No Action	140,247[a]
Storage and Disposition	460[b]
Foreign Research Reactor Spent Nuclear Fuel	1.9
HEU Disposition	2.1
[Text deleted.]	
Spent Nuclear Fuel	49
Stockpile Stewardship and Management	46
Tritium Supply and Recycling	4,735
Waste Management	325[c]
Total annual cumulative water usage	145,883.1

[a] Includes both groundwater and surface water usage (13,247 million l/yr from groundwater and 127,000 million l/yr from surface water).

[b] Collocation Alternative.

[Text deleted.]

[c] Based on preliminary data.

[Text deleted.]

Source: DOE 1995i; DOE 1995p; DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996g; DOE 1996m; SR DOE 1994b; SR DOE 1995b; SRS 1995a:1; Table 4.2.6.4–1.

Table 4.7.2.6.4–2. Cumulative Annual Wastewater Discharge at Savannah River Site

Program	Nonhazardous Sanitary and Industrial Wastewater (million l/yr)
No Action	700
Storage and Disposition	215
Foreign Research Reactor Spent Nuclear Fuel	1.6
HEU Disposition	18.7
[Text deleted.]	
Spent Nuclear Fuel	49
Stockpile Stewardship and Management	46
Tritium Supply and Recycling	143
Waste Management	83[a]
Total annual cumulative wastewater	1,256.3

[a] Based on the highest treated volumes from the alternative scenarios.

[Text deleted.]

Source: DOE 1995i; DOE 1995p; DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996g; DOE 1996m; SR DOE 1994b; SR DOE 1995b; SRS 1995a:1; Table 4.2.6.4–1.

4.7.2.6.5 *Geology and Soils*

Cumulative impacts to geologic and soil resources are expected to be minor as a result of the storage alternatives and the other DOE programs identified in Table 4.7.1–1. A total of 223 ha (550 acres) could be disturbed at the site. Soil erosion and storm water control measures would be used during construction to minimize erosion from the disturbed areas. No valuable geologic resources would be affected by any of the planned programs.

4.7.2.6.6 *Biological Resources*

In addition to ongoing activities and the Storage Alternatives, SRS is being considered for the other DOE programs identified in Table 4.7.1–1. While a number of these would be located within existing structures or developed areas of SRS, others would be constructed at undisturbed sites. The total area of undeveloped land used by new facilities would be 223 ha (550 acres), or about 0.3 percent of the total SRS area. Discharges from the proposed facilities would be directed to a number of site waterbodies, thus increasing the possibility of cumulative impacts to wetlands and aquatic resources in these waterbodies. The cumulative loss of habitat could lead to additional impacts to special status species compared to those resulting from construction of a storage facility alone; however, their status on SRS would not be expected to be jeopardized. Species that could be affected include green-fringed orchid, nailwort, beak-rush, [text deleted], Florida false loosestrife, Cooper's hawk, and eastern tiger salamander. Red-cockaded woodpeckers colonies are located far enough from the sites that they would not be affected by the facilities.

4.7.2.6.7 *Cultural and Paleontological Resources*

The six other DOE programs identified in Table 4.7.1–1 may require ground-disturbing construction, facility modification, and changes in land access and use at SRS. New construction is proposed for some currently undeveloped land within SRS under both the Tritium Supply and Recycling and Storage and Disposition programs. Portions of this undeveloped land have been surveyed and contain NRHP-eligible resources which may be affected by construction. Building modification is also proposed under several programs. Facilities at SRS have not been reviewed for NRHP-eligibility, but many may be eligible based on their association with the Cold War. Specific surveys, evaluations, and Native American consultations would be conducted pursuant to NHPA, the *American Indian Religious Freedom Act*, and the *Native American Graves Protection and*

Repatriation Act. There is potential for moderate cumulative impacts to cultural resources at SRS based on the presence of sites and facilities that have been or are likely to be determined eligible for listing on the NRHP.

4.7.2.6.8 *Socioeconomics*

Cumulative impacts on SRS's regional economy, population, housing, community services, and local transportation would be minor. Generally, the regional economy would improve without burdening the housing market, but new traffic could cause congestion on local roads. Because each of the other six DOE programs identified in Table 4.7.2.6.8–1 is relatively small, their cumulative socioeconomic impact is expected to be minor. The primary impact will be to stimulate regional economic growth. If all of these programs were located at SRS, transportation congestion and the demand for new housing and other public services could increase. However, housing construction trends indicate that this additional population could be accommodated without significant impacts to the housing market.

Table 4.7.2.6.8–1. Socioeconomic Cumulative Impacts at Savannah River Site

Program	Direct Employment[a]
Storage and Disposition[b]	614
Foreign Research Reactor Spent Nuclear Fuel	30
HEU Disposition	125
Spent Nuclear Fuel	0
Stockpile Stewardship and Management	810
Tritium Supply/Recycling	600
Waste Management	5,670
Total	7,849

[a] Operations.
[b] Collocation Alternative.
Source: DOE 1995i; DOE 1995p; DOE 1995cc; DOE 1996b; DOE 1996g; DOE 1996m; Section 4.2.6.8.

4.7.2.6.9 *Public and Occupational Health and Safety*

Radiological Impacts. The maximum incremental radiological doses and resulting health effects for the storage alternative, the No Action Alternative and other actions planned at SRS, are presented in Table 4.7.2.6.9–1. Although these impacts could be added, it should be noted that the exact locations of the facilities for planned actions may change. In addition, because each of these facilities is sited in a different location, the location of the MEI for each is also different. The MEIs have been selected to maximize the potential dose for a given facility. Since the MEI would have to be resident at more than one location simultaneously in order to receive the maximum dose from each facility, summing the doses would be misleading. The offsite population and total site workforce doses have not been summed because the population distribution and workforce totals as analyzed vary among the actions. [Text deleted.]

Chemical Impacts. For SRS, the various NEPA documents use different but otherwise acceptable methodologies to assess the health effects from hazardous chemical exposure for proposed activities. These methodologies may have different indicators for determining the health impact (for example, hazard index, cancer risk, or chemical concentration in the environment). These different indicators prevent a uniform quantitative cumulative impact analysis for this site. However, as indicated in the health impact analysis sections in the NEPA documents for the proposed actions, the health effect from any proposed action at SRS is predicted to contribute only slightly to the impacts from the baseline activity (No Action). The potential cumulative health impact from hazardous chemicals from implementation of the proposed activities would not exhibit a noticeable increase above the baseline, would be expected to fall within acceptable regulatory limits.

Table 4.7.2.6.9–1. Estimated Average Annual Cumulative Radiological Doses and Resulting Health Effects to the Public and Workers From Normal Operation at Savannah River Site

Program	Maximally Exposed Member of the Public		Offsite Population Within 80 km		Total Site Workforce	
	Total Dose (mrem)	Fatal Cancer Risk	Total Dose (person-rem)	Number of Fatal Cancers	Total Dose (person-rem)	Number of Fatal Cancers
No Action	0.79	$4.0x10^{-7}$	44	0.022	259	0.090
Storage and Disposition[a]	$1.4x10^{-5}$	$7.0x10^{-12}$	$8.8x10^{-4}$	$4.4x10^{-7}$	25	0.010
Foreign Research Reactor Spent Nuclear Fuel	$1.8x10^{-4}$	$9.0x10^{-11}$	0.010	$5.3x10^{-6}$	32	0.013
HEU Disposition	$2.5x10^{-3}$	$1.3x10^{-9}$	0.16	$8.0x10^{-5}$	11.3	$4.5x10^{-3}$
[Text deleted.]						
Spent Nuclear Fuel	0.50	$2.5x10^{-7}$	18.4	$9.2x10^{-3}$	76	0.034
Stockpile Stewardship and Management	$1.0x10^{-5}$	$5.0x10^{-12}$	$5.9x10^{-4}$	$3.0x10^{-7}$	156	0.062
Tritium Supply and Recycling[b]	2.5	$1.2x10^{-6}$	210	0.11	42	0.017
Waste Management	0.033	$1.7x10^{-8}$	1.5	$7.5x10^{-4}$	81	0.032
[Text deleted.]						

[a] The impacts from the collocation storage facility are presented since they encompass both Pu and HEU storage.

[b] Accelerator Production of Tritium Alternative.

Source: DOE 1995i; DOE 1995p; DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996g; DOE 1996m; Tables 4.2.6.9–1 and 4.2.6.9–2.

4.7.2.6.10 *Waste Management*

Cumulative impacts to waste management at SRS could arise from any of the reasonably foreseeable future actions as identified in Table 4.7.2.6.10–1. The largest potential contribution to cumulative impacts would result from the Waste Management PEIS if SRS were selected as a regional site for HLW storage, TRU waste treatment and storage, and mixed LLW and LLW treatment and disposal site. The Collocation Alternative for the Storage and Disposition PEIS would contribute to the cumulative impacts for LLW.

Table 4.7.2.6.10–1. Waste Management Cumulative Impacts at Savannah River Site (2005)—Annual Volumes

Category	No Action[a] (m^3)	Storage and Disposition[b] (m^3)	Foreign Research Reactor Spent Nuclear Fuel (m^3)	HEU EIS[c] (m^3)	Spent Nuclear Fuel Management (m^3)	Stockpile Stewardship and Management[d] (m^3)	Tritium Supply and Recycling (m^3)	Waste Management (m^3)	Total (m^3)
Spent Fuel	0	0	1.4 t	0	0.4 t	0	0	0	2 t
High Level									
Liquid	126	0	0	0	0	0	0	0	126
Solid	3,525	0	0	0	0	0	0	533[e]	4,060
Transuranic									
Liquid	0	0.02	0	0	0	28	0	Included in solid	28
Solid	338	2	0	0	20	129	0	445[f]	934
Mixed Transuranic									
Liquid	0	0	0	0	0	0	0	Included in TRU	0
Solid	Included in TRU	4	0	0	0	11	0	Included in TRU	15
Low-Level									
Liquid	74,000	2.1	0	22	0	80	0	Included in solid	74,100
Solid	16,400	1,260	673	76	400	88	416	26,835[g]	46,150
Mixed Low-Level									
Liquid	1,330	0.2	NA	46	0	0	0	0	1,380
Solid	7,970	66	NA	0	0	0	5	340[h]	8,110
Hazardous									
Liquid	1,260	2	NA	88	NA	0.5	0	Included in solid	1,350
Solid	15,100	2	NA	0	NA	0	2	151[i]	15,300
Nonhazardous (Sanitary)									
Liquid	703,000	195,780	NA	18,800	NA	46,200	925,076	NA	1,870,000
Solid	61,200	18[j]	NA	410	NA	1,450	917	NA	64,000

Table 4.7.2.6.10–1. Waste Management Cumulative Impacts at Savannah River Site (2005)—Annual Volumes—Continued

Category	No Action[a] (m³)	Storage and Disposition[b] (m³)	Foreign Research Reactor Spent Nuclear Fuel (m³)	HEU EIS[c] (m³)	Spent Nuclear Fuel Management (m³)	Stockpile Stewardship and Management[d] (m³)	Tritium Supply and Recycling (m³)	Waste Management (m³)	Total (m³)
Nonhazardous (Other)									
Liquid	Included in sanitary	Included in sanitary	38,450	Included in sanitary	NA	Included in sanitary	Included in sanitary	35,417[k]	74,600
Solid	Included in sanitary	2,300[l]	NA	410[l]	NA	1,450[l]	0	NA	4,160

[a] No Action volumes from Table 4.6.2.10–1.

[b] Collocation Alternative (New Pu and HEU Storage Facility).

[c] Blending HEU to 4 percent LEU as UNH.

[d] Pit Fabrication Alternative.

[e] Represents HLW Regionalized Alternative 1, in which SRS would receive a total of 300 canisters from West Valley Demonstration Project for storage awaiting availability of geologic repository. Receipt of 100 canisters per year was assumed (Draft Waste Management PEIS, Vol I of IV, Table 9.1–1, page 9–3).

[f] Represents TRU waste Regionalized Alternatives 2 and 3, in which SRS would treat its TRU waste and contact-handled TRU waste from several other facilities. The volume was obtained by taking the estimated inventory at SRS plus the estimated inventory and 20-year generation projection for offsite facilities and dividing by 20 to get an annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 8.1–1, page 8–4).

[g] Represents LLW Regionalized Alternatives 6 and 7, in which SRS disposes of wastes, its LLW, and LLW from several other facilities. The volume was obtained by taking the estimated inventory at SRS plus the estimated inventory and 20-year generation projection for offsite facilities and dividing by 20 to get an annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 7.1–1, page 7–3).

[h] Represents mixed LLW Regionalized Alternative 2, in which SRS treats and disposes of its mixed LLW and mixed LLW from several other facilities. The volume was obtained by taking the estimated inventory at SRS plus the estimated inventory and 20-year generation projection for offsite facilities and dividing by 20 to get an annual estimate (Draft Waste Management PEIS, Vol. I of IV, Table 6.1–1, page 6–3).

[i] Represents hazardous waste Regionalized Alternative 1, in which SRS would treat onsite approximately 55 percent of its hazardous waste with the remainder going to commercial facilities. One metric ton of hazardous waste is approximately 1 cubic meter in volume (Draft Waste Management PEIS, Vol. I of IV, Table 10.3–7, page 10–20).

[j] Upgrade with RFETS and LANL material Alternative.

[k] Represents the total incremental wastewater over No Action for all alternatives. Annual volume estimated by assuming 365 days per year (Draft Waste Management PEIS, Vol II, Tables II-16.4–8 [HLW], page 16–55; II-16.3–11 [TRU], page 16–45; II-16.2–12 [LLW], page 16–32; II-16.1–16 [mixed LLW], page 16–18; and II-16.5–10 [hazardous], page 16–67).

[l] Recyclable wastes.

Note: NA=data was not analyzed in the associated PEIS.

Source: 60 FR 28680; 60 FR 63878; 60 FR 65300; 61 FR 9441; 61 FR 25092; DOE 1995i; DOE 1995p; DOE 1995cc; DOE 1995dd; DOE 1996b; DOE 1996g; DOE 1996m; SR DOE 1995b; SR DOE 1995c; SR DOE 1995e; Table 4.2.6.10–1.

4.7.2.7 Rocky Flats Environmental Technology Site

4.7.2.7.1 *Land Resources*

Since no new construction would be needed for any of the storage alternatives, there would be no cumulative impacts to land resources. In the case of phaseout, future use of the facility would be consistent with the land use plans outlined in site development plans.

4.7.2.7.2 *Site Infrastructure*

Since no storage alternatives would be implemented at RFETS, no major site infrastructure enhancements are anticipated, and there would not be any obvious cumulative impacts. Table 4.2.7.2–1 shows that all site infrastructure categories reported still have sufficient reserve capacity to support ongoing missions.

4.7.2.7.3 *Air Quality and Noise*

Operations at the RFETS are currently in compliance with the NAAQS as well as State regulations and guidelines. Air emissions attributable to the interim storage and phaseout of Pu would not increase concentrations of criteria pollutants. The cumulative impacts are the same as No Action concentrations except for increases in SO_2 concentrations resulting from waste management activities and are in compliance with Federal and State regulations (DOE 1995dd:14-9,14-24,14-38).

Cumulative noise impacts include contributions from existing and planned facilities including the storage facilities at the site. Noise impacts may result both from onsite noise sources and from offsite sources such as traffic. Noise impacts on individuals from the storage facilities are expected to be small, resulting in little or no increase in noise levels at offsite areas. No increase in cumulative noise impacts to offsite individuals is expected to occur.

4.7.2.7.4 *Water Resources*

Since no additional water would be needed for any of the storage alternatives, the storage program would not contribute to cumulative impacts for water resources at RFETS. There may be a decrease in water usage and wastewater generation as a result of the phaseout alternative. The benefits as a result of the phaseout alternative are expected to be negligible.

[Text deleted.]

4.7.2.7.5 *Geology and Soils*

Since no ground disturbing activities would be needed for any of the storage alternatives, there would not be cumulative impacts to geology and soils.

4.7.2.7.6 *Biological Resources*

Since no facility construction would be needed to accommodate any of the storage options, there would be no cumulative impacts to biological resources at the site.

4.7.2.7.7 *Cultural and Paleontological Resources*

Some cumulative impacts are possible at RFETS as a result of alternatives in the Waste Management PEIS. In the case of the phaseout alternative for the storage program, additional impacts could result if potentially NRHP-eligible structures were modified for other uses.

4.7.2.7.8 Socioeconomics

The cumulative impacts resulting from the Storage Alternatives at RFETS on the regional economy, population, housing, community services, and local transportation would be minor. In addition to the proposed phaseout of the storage mission, the only other DOE action being considered for RFETS is the Waste Management program. As shown in Table 4.7.2.7.8–1, employment generated by the Waste Management program would offset some of the job losses resulting from phaseout of the storage mission. However, the combined impact of these two actions would be to reduce the workforce from the No Action level. The cumulative impact on the regional economy and ROI housing market and community services would be minor. Any transportation congestion that may exist on roads leading to the site would be reduced slightly due to fewer site workers.

Table 4.7.2.7.8–1. Socioeconomic Cumulative Impacts at Rocky Flats Environmental Technology Site

Program	Direct Employment[a]
Storage and Disposition[b]	-2,129
Waste Management	1,344
Total	-785

[a] Operations.
[b] Phaseout Alternative.
Source: DOE 1995cc; Section 4.2.7.8.

4.7.2.7.9 Public and Occupational Health and Safety

No additional radiological or chemical impacts are expected as a result of the storage alternatives at RFETS. Therefore, the contribution to cumulative impacts from the storage alternatives are the same as the No Action impacts shown in Section 4.2.7.9.

4.7.2.7.10 Waste Management

No additional waste would be generated as a result of the No Action or phaseout alternatives at RFETS. Therefore, the storage alternatives would not contribute to cumulative impacts.

4.7.2.8 Los Alamos National Laboratory

4.7.2.8.1 *Land Resources*

Since none of the alternatives would require additional ground disturbance, the storage alternatives would not contribute to cumulative impacts that may result from the two other DOE programs identified in Table 4.7.1–1. In the case of phaseout, any future use of the facility would be consistent with the land uses outlined in site development plans.

4.7.2.8.2 *Site Infrastructure*

Some cumulative impacts are possible at LANL from the implementation of the two other DOE programs identified in Table 4.7.1–1. However, since none of the storage alternatives would require facility construction or modification, the cumulative impacts would not be affected by this program.

4.7.2.8.3 *Air Quality and Noise*

Operations at LANL are currently in compliance with NAAQS and State regulations and guidelines. Air emissions attributable to the No Action and phaseout alternatives would not increase concentrations of criteria pollutants. The contribution to cumulative impacts from the storage alternatives are the same as the No Action concentrations shown in Section 4.2.8.3.

Cumulative noise impacts include contributions from existing and planned facilities including the storage facilities at the site. Noise impacts may result both from onsite noise sources and offsite sources such as traffic. Noise impacts on individuals from the storage alternatives are expected to be small, resulting in little or no increase in noise levels at offsite areas. No increase in cumulative noise impacts is expected to occur as a result of the storage alternatives.

4.7.2.8.4 *Water Resources*

Since no additional water would be needed for any of the storage alternatives, the storage program would not contribute to cumulative impacts for water resources at LANL. There may be a decrease in water usage and wastewater generation as a result of the phaseout alternative. The benefits to water resources as a result of the phaseout alternative are expected to be negligible.

4.7.2.8.5 *Geology and Soils*

Since no ground disturbing activities would be needed for any of the storage alternatives, there would be no contribution to cumulative impacts for geology and soils at LANL.

4.7.2.8.6 *Biological Resources*

Since no ground disturbing activities would be needed for any of the storage alternatives, there would be no contribution to cumulative impacts for biological resources at LANL.

4.7.2.8.7 *Cultural and Paleontological Resources*

Some cumulative impacts are possible at LANL as a result of the two DOE programs identified in Table 4.7.1–1. In the case of the phaseout alternative for the storage program, additional impacts could result if potentially NRHP-eligible structures were modified for other uses.

4.7.2.8.8 *Socioeconomics*

The storage alternatives would result in no loss of jobs at LANL. In the case of phaseout, workers currently employed in the P-storage area would be relocated to other areas. Therefore, the storage alternatives would not contribute to cumulative impacts that may result from other DOE programs.

4.7.2.8.9 *Public and Occupational Health and Safety*

No additional radiological or chemical impacts are expected as a result of the storage alternatives at LANL. Therefore, the contribution to cumulative impacts from the storage alternatives are the same as the No Action impacts shown in Section 4.2.8.9.

4.7.2.8.10 *Waste Management*

No additional waste would be generated as a result of the No Action or phaseout alternatives at LANL. Therefore, the storage alternatives would not contribute to cumulative impacts that may result from the two other DOE programs identified in Table 4.7.1–1.

4.7.3 DISPOSITION ALTERNATIVES CUMULATIVE IMPACTS

Implementation of the various proposed disposition alternatives may result in incremental cumulative impacts in addition to the long-term storage cumulative impacts identified in Section 4.7.2. The impacts identified in this section are additive to the cumulative impacts identified in the long-term storage cumulative impact analysis.

A site-specific cumulative impact analysis was not performed for the disposition alternatives, because only representative or generic sites were considered. Instead, a generic cumulative impact analysis that is applicable to all DOE sites was developed for the disposition alternatives. Future tiered NEPA documents will provide detailed site-specific cumulative impact analyses.

Since there are multiple combinations of disposition operations and facilities that could be selected, a representative scenario was used for the disposition cumulative impact analysis. This scenario includes all of the common activities that would be needed for all of the disposition alternatives (pit disassembly/conversion and Pu conversion facilities), the common activity that would be required for the reactor alternatives (MOX fuel fabrication facility), and the immobilization alternative that would generally have the largest impacts (ceramic immobilization facility). For consistency, all analyses assume use of the ceramic immobilization technology. The scenario conservatively assumes that all four of the facilities would be constructed and operated concurrently at the same DOE site. The following sections describe the impacts from the disposition scenario for each resource area.

4.7.3.1 Land Resources

The contribution to land-use cumulative impacts from the disposition scenario is shown in Table 4.7.3.1–1. The construction of all four of the disposition scenario facilities at the same site would disturb up to 191 ha (474 acres) of land during construction, of which up to 133 ha (330 acres) would be used during operations. If all four of the facilities were located at the same site, there would likely be a reduced area of disturbed land due to the sharing of land resources. In addition, optimal use of existing buildings and facilities would occur where possible. The site chosen for the disposition scenario would likely have adequate land area to accommodate the facilities. If the site development is not in conformance with existing land-use plans, it may be possible for land-use plans, policies, and controls to be revised. The use of special status lands and prime farmland could be affected. It is anticipated that the new facilities would be relatively visually unobtrusive to adjacent lands.

Table 4.7.3.1–1. Contribution to Land-Use Cumulative Impacts From the Disposition Scenario

Area of Disturbance (ha)	Pit Disassembly/ Conversion	Pu Conversion	MOX Fuel Fabrication	Ceramic Immobilization	Total Impact
Construction	14	36	121	20	191
Operation	12	28	81	12	133

Source: Section 4.3.1.1; Section 4.3.2.1; Section 4.3.4.2.1; Section 4.3.5.1.1.

4.7.3.2 Site Infrastructure

The contribution to site infrastructure cumulative impacts from the disposition scenario is shown in Table 4.7.3.2–1. The additional resource requirements could require new transmission lines, oil storage tanks, and gas transfer pipelines. Additional fuel oil and natural gas requirements would probably be available using the current procurement practices at the site. If the natural gas requirement is not available, oil-based utilities could substitute. Construction and operation of these facilities would require the construction of transportation links to existing road and rail networks.

Table 4.7.3.2–1. Contribution to Site Infrastructure Cumulative Impacts From the Disposition Scenario[a]

Utility	Pit Disassembly/ Conversion	Pu Conversion	MOX Fuel Fabrication	Ceramic Immobilization	Total Impact
Electrical Energy (MWh/yr)	20,000	21,000	13,000	25,000	79,000
Peak Load (MWe)	5	5	5	3	18
Oil (l/yr)	28,000	39,750	20,000	190,000	277,750
Natural gas (m^3/yr)	3,398,000	4,361,000	2,350,000	3,500,000	13,609,000

[a] Operations only.
Source: Section 4.3.1.2; Section 4.3.2.2; Section 4.3.4.2.2; Section 4.3.5.1.2.

4.7.3.3 Air Quality and Noise

The construction and operation of the disposition scenario facilities would result in the emission of some air pollutants at each of the sites. The modeling needed to determine the concentrations of the pollutants is highly site-specific. The concentrations would vary depending on the ambient conditions of each of the sites. Air pollutant emission sources include exhaust from vehicles, emissions from facility processes, boiler and generator emissions, and fugitive dusts from land clearing and site preparation. Concentrations of criteria and toxic/hazardous pollutants during construction and operation of the facilities may not be in compliance with Federal, State, and local regulations and guidelines.

4.7.3.4 Water Resources

The contribution to water resource cumulative impacts from the disposition scenario is shown in Table 4.7.3.4–1. The disposition scenario facilities would obtain raw water from surface or groundwater sources that currently support the site. Most of the DOE sites analyzed would have adequate water supply to support the proposed projects. Wastewater would be treated using existing treatment, monitoring, and discharge systems. New wastewater treatment systems would be constructed if the current systems do not have adequate capacity.

Table 4.7.3.4–1. Contribution to Water Resource Cumulative Impacts From the Disposition Scenario[a]

Water Resource Requirement (million l/yr)	Pit Disassembly/ Conversion	Pu Conversion	MOX Fuel Fabrication	Ceramic Immobilization	Total Impact
Total water requirement	94.6	80.5	56.8	250	481.9
Total wastewater discharge	85.2	15	43.5	98	241.7

[a] Operations only.
Source: Section 4.3.1.4; Section 4.3.2.4; Section 4.3.4.2.4; Section 4.3.5.1.4.

4.7.3.5 Geology and Soils

Construction of the disposition scenario facilities would involve disturbing up to 191 ha (474 acres) of land. The ground disturbing activities would lead to a temporary increase in the erosion potential of the exposed soils. The disposition scenario facilities are not expected to restrict access to potential geologic resources.

4.7.3.6 Biological Resources

Construction and operation of the disposition scenario facilities could result in the direct disturbance of terrestrial resources, wetlands, and threatened and endangered species. Construction of the disposition scenario facilities would involve disturbing up to 191 ha (474 acres) of land. 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. Nests and young animals living within the project area would not be expected to survive. Surrounding areas could be indirectly affected by erosion and sedimentation. The use of existing buildings and previously disturbed areas would reduce impacts.

4.7.3.7 Cultural and Paleontological Resources

The construction and operation of the disposition scenario facilities could affect cultural and paleontological resources. Construction of the facilities could disturb up to 191 ha (474 acres) of land. Cultural and paleontological resources could be affected by ground disturbance, building modification, visual intrusion, audio intrusion, disruption of historic and/or environmental setting, reduced access to traditional use areas, unauthorized artifact collecting, and vandalism. Construction and operation of the facilities could affect Native American and buried paleontological materials.

4.7.3.8 Socioeconomics

The contribution to socioeconomic cumulative impacts from the disposition scenario is shown in Table 4.7.3.8–1. Constructing and operating the disposition scenario facilities would generate employment and income increases in the region. In-migrating workers may be needed to fill specialized positions during construction and operation. Housing units, in excess of existing vacancies, may be required during construction and operation of the facilities. Operation of the facilities would result in an increased demand for community services at the selected site. There may be an increase in congestion on local roads as a result of new traffic from construction and operation workers. Generally, the impacts from the new facilities would be minor relative to the size of the regional population and economy.

Table 4.7.3.8–1. Contribution to Socioeconomic Cumulative Impacts From the Disposition Scenario

Labor Category	Pit Disassembly/ Conversion	Pu Conversion	MOX Fuel Fabrication	Ceramic Immobilization	Total Impact
Direct construction workers	125	358	475	1,000	1,958
Direct operational workers	830	883	500	860	3,073

Source: Section 4.3.1.8; Section 4.3.2.8; Section 4.3.4.2.8; Section 4.3.5.1.8.

4.7.3.9 Public and Occupational Health and Safety

The contribution to public and occupational health and safety cumulative impacts are shown in Table 4.7.3.9–1. During normal operations of the disposition scenario facilities, there would be both radiological and chemical releases to the environment and direct in-plant exposures. However, concentrations are expected to be within regulated exposure limits.

4.7.3.10 Waste Management

The contribution to waste management cumulative impacts from the disposition cumulative impacts is shown in Table 4.7.3.10–1. Existing treatment systems would be used for the wastestreams from the disposition scenario facilities. If capacity or appropriate treatment technology is not available, new treatment facilities would be built to handle the waste from the new facilities.

Table 4.7.3.9–1. Contribution to Public and Occupational Health and Safety Cumulative Impacts From the Disposition Scenario[a]

Receptor	Pit Disassembly/ Conversion	Pu Conversion	MOX Fuel Fabrication	Ceramic Immobilization
Maximally Exposed Individual Member of the Public				
Annual dose (mrem/yr)	$1.5x10^{-3}$ to $1.4x10^{-2}$	$9.5x10^{-5}$ to $9.2x10^{-3}$	$8.8x10^{-5}$ to 0.015	$1.2x10^{-7}$ to $4.2x10^{-6}$
Fatal cancer risk[b]	$7.6x10^{-10}$ to $7.0x10^{-8}$	$4.8x10^{-10}$ to $4.6x10^{-8}$	$7.8x10^{-10}$ to $1.8x10^{-7}$	$6.0x10^{-13}$ to $2.1x10^{-11}$
Public Within 80 km				
Annual dose (person-rem/yr)	$2.9x10^{-4}$ to 0.12	$1.9x10^{-4}$ to 0.074	$1.4x10^{-4}$ to 0.14	$1.7x10^{-7}$ to $6.7x10^{-5}$
Fatal cancers[b]	$1.5x10^{-6}$ to $6.0x10^{-4}$	$9.5x10^{-7}$ to $3.7x10^{-4}$	$1.2x10^{-6}$ to $1.2x10^{-3}$	$8.5x10^{-10}$ to $3.4x10^{-7}$
Involved Worker				
Annual dose (mrem/yr)	200	233	250	279
Fatal cancer risk[b]	$8.0x10^{-4}$	$9.3x10^{-4}$	$2.3x10^{-3}$	$1.1x10^{-3}$
Total Involved Workforce				
Annual dose (mrem/yr)	83	133	31	120
Fatal cancers[b]	0.34	0.53	0.29	0.46
Hazardous Chemical Impacts				
Maximally Exposed Individual of the Public				
Hazard index	$4.0x10^{-6}$ to $1.5x10^{-4}$	$7.9x10^{-6}$ to $1.7x10^{-4}$	$4.9x10^{-6}$ to $1.9x10^{-4}$	$3.9x10^{-4}$ to $1.5x10^{-2}$
Cancer risk[b]	0	$4.7x10^{-9}$ to $1.9x10^{-7}$	0	0
Site Worker				
Hazard index	$2.6x10^{-4}$ to $5.3x10^{-4}$	$8.0x10^{-4}$ to $1.7x10^{-3}$	$8.2x10^{-4}$ to $1.7x10^{-3}$	$8.3x10^{-2}$ to 0.17
Cancer risk[b]	0	$7.2x10^{-6}$ to $1.5x10^{-5}$	0	0

[a] During normal operations.

[b] Over the operational life.

Note: The impacts projected in this table are for 50t for either immobilization or reactor burning. The pit dissassembly/conversion, Pu conversion, and ceramic immobilization impacts are for 10 years and the MOX fuel fabrication impacts are for 17 years.

Source: Section 4.3.1.9; Section 4.3.2.9; Section 4.3.4.2.9; Section 4.3.5.1.9.

Table 4.7.3.10–1. Contribution to Waste Management Cumulative Impacts From the Disposition Scenario[a]

Waste Category	Pit Disassembly/ Conversion (m^3/yr)	Pu Conversion (m^3/yr)	MOX Fuel Fabrication (m^3/yr)	Ceramic Immobilization (m^3/yr)	Total Impact (m^3/yr)
Transuranic					
Liquid	0	3.2	0	75	78.2
Solid	67	278	306	99	750
Mixed Transuranic					
Liquid	0	0	0	0	0
Solid	4	191	4	0.7	200
Low-Level					
Liquid	4	56	4	7	70
Solid	102	1,743	153	14	2,012
Mixed Low-Level					
Liquid	0.4	0.04	0.8	0	1
Solid	1.7	191	38	0.15	231
Hazardous					
Liquid	2	2	4	38	46
Solid	0.7	11	153	19	184
Nonhazardous (Sanitary)					
Liquid	85,200	15,000	43,300	34,000	177,500
Solid	100	2,060	76	920	3,160
Nonhazardous (Other)					
Liquid	Included in sanitary	56	227	170,000	170,300
Solid	3	0	84[b]	15	102

[a] Operations only.

[b] Includes recyclable waste.

Source: Section 4.3.1.10; Section 4.3.2.10; Section 4.3.4.2.10; Section 4.3.5.1.10.

4.8 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Siting, construction, and operation of facilities for both the long-term storage and disposition of weapons-usable fissile materials at Hanford, NTS, INEL, Pantex, ORR, and SRS, and for disposition facilities evaluated at generic sites would result in some unavoidable environmental impacts. The impact assessment conducted in this PEIS has identified potential impacts, along with mitigation measures that could be implemented to minimize them. The impacts that would remain following mitigation actions are unavoidable; the potential impacts of all alternatives at all sites are discussed below.

Land

At each of the long-term storage analysis sites, up to 87 ha (215 acres) of land would be required during operation of the collocated storage facilities, including necessary supporting infrastructure and access roads. This requirement would represent a maximum of about 2 percent of the total land of any site. Construction and operation of some long-term storage facility alternatives at ORR and SRS would change the VRM classification from Class 4 to Class 5. This change would affect some key viewpoints with high sensitivity levels at ORR.

Under the disposition alternatives, up to 57 ha (141 acres) of land would be required during operation of the deep borehole disposition complex, with necessary supporting infrastructure and access roads. If sited at a generic location, additional land area for a 1.6-km (1-mi) buffer zone could be required. At least 142 ha (350 acres) of land area would be required to operate the evolutionary LWR facilities (for one reactor unit only), including necessary supporting infrastructure and access roads. The potential facility location for the evolutionary LWR at ORR is not within the site boundary. The evolutionary LWR would change the VRM classification of several analyses sites from Class 3 or 4 to Class 5. Other potential actions would change the VRM classification of several analyses sites from Class 4 to Class 5. Cooling towers and other large stacks associated with the disposition facilities would impact visual resources through their physical structure and vapor plumes, which would be visible during certain atmospheric conditions. Construction and operation of some disposition alternatives at ORR would affect key viewpoints with high sensitivity levels.

Site Infrastructure

There would be minor unavoidable impacts anticipated for site infrastructure for long-term storage or disposition activities.

Air Quality and Noise

Air pollutant concentrations would increase slightly or remain the same during construction and operation for long-term storage and disposition activities; however, during construction and operation the sites are expected to be in compliance with Federal, State, and local ambient air quality regulations or standards.

Water

Under the storage alternatives, the maximum amount of groundwater withdrawn would be approximately 190 million 1/yr (50.2 million gal/yr) at NTS for the modify P-Tunnel option of the Collocation Alternative. This would represent a 7.9-percent increase over the projected No Action water use, representing 0.5 percent of the minimum estimated recharge.

Under the disposition alternatives, the maximum amount of groundwater withdrawn would be approximately 341 million 1/yr (90 million gal/yr) at NTS, INEL, Pantex, and SRS for the evolutionary LWR. At Pantex, the amount of water withdrawal would result in minor drawdowns of the Ogallala Aquifer in the area. Total site groundwater withdrawal would be less than what is currently being withdrawn from the Ogallala Aquifer for industrial use at Pantex.

Geology and Soils

For long-term storage and disposition alternatives, soil erosion resulting from wind and stormwater runoff in disturbed areas would occur.

Biological

For long-term storage and disposition alternatives, federally listed threatened or endangered species, such as the desert tortoise and bald eagle, could be affected directly or by disruptions to foraging, breeding, and nesting habits during construction and operation of facilities. Several candidate or State-listed animal species and special status plant species could also be affected at different sites. While such disruptions may be unavoidable, appropriate measures could be implemented and monitored to ensure that any impacts would not be irreversible. Construction of new facilities would have some unavoidable impacts on animal populations. Larger animals and birds would move to similar habitats nearby if the habitats could sustain them, while less mobile animals within the disturbed areas, such as amphibians, reptiles, and small mammals, would not be expected to survive.

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.

Cultural Resources

Some NRHP-eligible prehistoric and historic resources may exist within the area to be disturbed at any potential long-term storage or disposition site. The appropriate SHPO and the Advisory Council on Historic Preservation would be consulted to minimize unavoidable impacts. Native American resources could be unavoidably affected by land disturbance, audio or visual intrusions on Native American sacred sites, or by reduced access to traditional use areas, or theft or vandalism. DOE would consult with the affected tribes to minimize any impacts. Paleontological resources could exist within acreage disturbed during construction of facilities. Construction activities would be monitored by a paleontologist to minimize any impacts to scientifically important paleontological materials.

Socioeconomics

Construction and operation of the long-term storage and disposition facilities at some sites could lead to increases in regional population, which would have an impact on the surrounding jurisdictions. For some alternatives, the additional population would increase the demand for community services including education, public safety, and health care. However, at none of the sites analyzed would the increase in demand exceed the capacity of the affected communities to provide these services. Implementing these proposed alternatives would increase traffic on the roads leading into some of the sites analyzed. The resulting increases in traffic congestion and accidents would be unavoidable and could require upgrading the affected roads to accommodate increase traffic and minimize accidents.

Public Safety and Health

During the normal operation of any of the storage facilities, there would be radiological releases to the environment and to workers. The largest increase in radiation dose to the MEI from annual storage operations would result from the collocated storage facilities at ORR. The dose to the MEI would be 4.5×10^{-5} mrem/yr and the associated risk of fatal cancer from the 50 year period of storage operations would be 1.1×10^{-9}. This same new facility operating at ORR would also result in the largest increase in dose to the population within 80 km (50 mi) of any site from annual storage operations. The dose to the ORR populations would be 8.7×10^{-4} person-rem/yr; in 50 years of storage operations, 2.2×10^{-5} excess fatal cancers could occur in this population. The largest increase in dose to the involved workforce from annual new storage operations would result from operation of the modified FMEF Pu storage facility at Hanford. The dose to this workforce would be 52 person-rem/yr; in 50 years of storage operations, one fatal cancer could occur in the workforce.

Hazardous and toxic chemicals would be present during construction and operation of the long-term storage facilities. Worker exposure to these chemicals would be unavoidable. The HI from the facility to the MEI for collocation at Pantex would be 2.0×10^{-4} and for collocation at ORR the cancer risk would be 1.6×10^{-7}. The HI from the facility to the onsite worker for collocation at INEL would be 1.9×10^{-3} and for modifying the P-Tunnel for consolidation or collocation at NTS the cancer risk would be 6.4×10^{-6}.

During the normal operation of any of the disposition facilities, there could also be radiological releases to the environment and to workers. The largest increase in radiation dose to the MEI from annual disposition operations would result from the operation of the evolutionary LWR at ORR. The dose to the MEI from a single evolutionary LWR would be 4.9 mrem/yr, and the associated risk of fatal cancer from the projected 17-year period of reactor operation would be 4.1×10^{-5}. The largest increase in dose to the population within 80 km (50 mi) of any site from annual disposition operations would be 32 person-rem from operation of a large evolutionary LWR at SRS; in the 17-year operational period, 0.27 excess fatal cancers could occur in this population from total site operations. The largest increase in annual dose to the workers from disposition operations would result from operation of the partially completed LWR. The dose to the involved workforce would be 380 person-rem/yr; in the projected 17-year period of operation of this reactor, 2.5 excess fatal cancers could result in the workforce.

Hazardous and toxic chemicals would be present during construction and operation of the disposition facilities. Worker exposure to these chemicals would be unavoidable. The HI from the ceramic immobilization facility to the MEI for the Ceramic Immobilization Alternative at Pantex and ORR would be 1.5×10^{-2} and the cancer risk for the Pu conversion facility at ORR would be 1.9×10^{-7}. The HI from the deep borehole complex to the onsite worker for the Direct Disposition Alternative would be 0.29 and the cancer risk for the Pu conversion facility at ORR would be 1.5×10^{-5}.

Waste Management

Construction and operation of long-term storage facilities would affect existing waste management activities by increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Increased hazardous wastes would require additional shipments to RCRA-permitted treatment and disposal facilities. Increased TRU waste would require new or expanded above-grade storage facilities and additional shipments to WIPP (depending on decisions made in the ROD associated with the supplemental EIS being prepared for the continued phased development of WIPP for disposal of TRU waste). The increased LLW for the Consolidation or Collocation Alternatives could require additional engineered trenches or vaults at some candidate sites. Generation of additional nonhazardous wastes could require the expansion of existing or construction of new liquid and solid waste treatment facilities, or could reduce the lifetimes of existing solid waste landfills.

Construction and operation of disposition facilities would affect existing waste management activities by increasing or initiating the generation of spent nuclear fuel for the reactor alternatives, and increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes for all disposition facilities with the exception of the existing LWR site. The deep borehole complex would require the construction of waste treatment and storage facilities. Construction of new or expansion of existing spent fuel storage facilities would be required at all sites for the reactor alternatives. Increased TRU waste would require new or expanded radwaste treatment facilities and above-grade storage facilities at some sites. Additional shipments to WIPP (depending on decisions made in the ROD associated with the supplemental EIS being prepared for the continued phased development of WIPP for disposal of TRU waste) would be required at all sites. Increased LLW would require additional LLW shipments from Pantex to NTS (assuming Pantex would continue the current practice of shipping LLW to NTS) and could require additional engineered trenches or vaults at some candidate sites. Increased mixed waste could require expansion of treatment capability developed at each of the sites as reflected in the individual site treatment plans which were developed to comply with the *Federal Facility Compliance Act*. Additional or expanded RCRA-permitted staging or storage areas would be required at the generic MOX facility and some of the representative sites. Construction of new or expansion of existing sanitary, utility, and process wastewater treatment systems would be required for alternatives where the increase waste stream volumes exceed the capacity. For those sites that would discharge to a publicly-owned treatment works, such as the partially completed LWR, expansion of pretreatment systems may be required. Generation of additional solid nonhazardous wastes could reduce the expected lifetimes of current solid waste landfills.

Transportation

Existing facilities would be used for continued storage, which is the baseline case to which the transportation impacts for other alternatives is compared. Under No Action for storage and disposition, there would be no transportation of materials, and thus no transportation risks incurred. For storage, the maximum total potential fatalities from the transportation of Pu and HEU would be 1.070 for the Collocation Alternative at Hanford. For disposition, the maximum total potential fatalities from the transportation of surplus Pu would be 5.65 for the Existing LWR, Partially Completed LWR, and Evolutionary LWR Alternatives.

4.9 AVOIDED ENVIRONMENTAL IMPACTS AND IMPACTS ON URANIUM INDUSTRIES

This section discusses the potential avoided environmental impacts from the reactor alternatives for disposition, which have not been addressed in previous sections. Avoided environmental impacts of using MOX fuel instead of traditional uranium fuel in LWR power plants are discussed in Section 4.9.1. The potential impacts from the reactor alternatives on the uranium mining and nuclear fuel cycle industries are analyzed in Section 4.9.1.4. Section 4.9.2 discusses the avoided environmental impacts of using MOX fuel in LWR power plants instead of fossil fuel power plants in the generation of electricity.

The analysis presented in this section is based on the assumption that all of surplus Pu would be used as MOX fuel. For the Preferred Alternative, 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 and used in existing reactors. Subsequently, the avoided environmental impacts from the Preferred Alternative would be 70 percent of the respective avoided impacts presented in this section.

Potential avoided health impacts due to the use of MOX fuel in the CANDU reactors are not presented. Avoided health impacts beyond the U.S. borders are not required to be analyzed. If the CANDU reactors were selected as part of a multilateral agreement among Russia, Canada, and the United States, subsequent tiered NEPA review would be conducted.

4.9.1 USE OF MIXED OXIDE FUEL INSTEAD OF TRADITIONAL LOW-ENRICHED URANIUM FUEL IN NUCLEAR POWER PLANTS

For the Preferred Alternative, surplus Pu would be converted to MOX fuel for use in existing commercial nuclear power plants. In this alternative, part of the current nuclear fuel cycle in the existing commercial nuclear power plants would be replaced. In the United States, the uranium nuclear fuel cycle for commercial nuclear power plants is normally considered to begin with mining uranium ore and end with the disposal of the final radioactive wastes. The typical uranium fuel cycle for LWRs without spent fuel reprocessing in the United States is illustrated in Table 4.9.1–1. The MOX fuel cycle steps for proposed reactor alternatives are also listed in Table 4.9.1–1 for comparison. The pit disassembly/conversion process would replace the current uranium fuel cycle steps from uranium ore mining through uranium enrichment (steps 1 through 4 in Table 4.9.1–1). The nuclear fuel fabrication and burning in reactors would also be slightly different.

Table 4.9.1–1. Comparison of Uranium Fuel and Mixed Oxide Fuel Cycles

Step	Uranium Fuel Cycle	MOX Fuel Cycle
1	Uranium mining	Pit disassembly/conversion
2	Uranium milling	NA
3	Uranium conversion	NA
4	Uranium enrichment	NA
5	Uranium preparation and uranium fuel element fabrication	Uranium preparation and MOX fuel element fabrication
6	Nuclear power plants fueling–burning in the reactor	Nuclear power plants fueling–burning in the reactor
7	Spent fuel storage	Spent fuel storage

Note: NA=not applicable.

This section discusses the avoided environmental impacts of using the MOX fuel in existing LWRs. For the Existing LWR Alternative, the avoided environmental impacts would be due to the substitution of the MOX fuel for LEU (UO_2) fuel in LWRs. The existing LWRs are already in operation, and substitution of MOX fuel for uranium fuel may avoid some human health and environmental impacts.

4.9.1.1 Avoided Radiological Human Health Impacts

In the LWR uranium fuel cycle, contributors to the potential impacts on human health and the environment include uranium mining, uranium milling, and uranium conversion (from triuranic octaoxide [U_3O_8] to uranium hexafluoride [UF_6]). The other nuclear fuel cycle processes (enrichment plants, fuel fabrication plants) have considerably lower radioactive emissions than previous steps of the fuel cycle (mining, milling, and conversion). A summary of the atmospheric emissions of radioactive materials from the uranium fuel cycle and the MOX fuel cycle is shown in Table 4.9.1.1–1. Radioactive materials released into any liquid effluent are considerably less than the atmospheric emission and are not addressed.

By replacing the current uranium fuel cycle with MOX fuel, the uranium mining, milling, conversion, and enrichment are eliminated. As a result, the potential impacts to human health and the environment in the uranium fuel cycle process are reduced. Although the pit disassembly/conversion and MOX fuel fabrication processes create other impacts to the workers and public, the magnitude of these impacts are smaller than those of the uranium mining, milling, and conversion processes. Tables 4.9.1.1–2 and 4.9.1.1–3 compare the potential radiological impacts to the public and involved workers respectively, between the current fuel cycle process and the proposed MOX fuel cycle in existing LWRs.

For the general public within 80 km (50 mi), the expected latent cancer fatalities (LCFs) per year of operation would be 2.1×10^{-2} to 3.4×10^{-2} for the current uranium fuel cycle process and 2.7×10^{-3} to 1.4×10^{-2} for the proposed MOX fuel cycle burning in the two full MOX core existing LWRs. The avoided LCFs to the public then are 0.020 per year due to the substitution of MOX fuel for uranium fuel in LWRs. The total avoided LCFs for the public over the lifetime of the project (17 years) then would be 0.34, which represents the lower bounds of avoided health impact. For the Existing LWR Alternative, it would need three to five reactors that operate with the partial MOX core over their operating lifetime, which is equivalent to the two full core LWRs. Also the Preferred Alternative would dispose of the 70 percent of the surplus Pu in the existing reactors. Therefore, for the Preferred Alternative, the avoided impacts would be 0.24 LCFs for the general public.

For the involved workers, the expected LCFs per year of operation are 0.92 to 1.3 for the current uranium fuel cycle and 0.21 to 0.55 for the proposed MOX fuel cycle in existing LWRs. The avoided LCFs for the involved workers then are 0.75 per year due to the substitution of MOX fuel for uranium fuel in LWRs. The total avoided LCFs to the involved workers over the lifetime of the project (17 years) then are about 13. The Existing LWR Alternative would need three to five reactors that operate with the partial MOX core over their operating lifetime, which is equivalent to the two full core LWRs. For the Existing LWR Alternative, for analysis purposes, 70 percent of the surplus Pu was assumed to be used in existing LWRs. Therefore, for the Existing LWR Alternative, the avoided impacts would be 9.1 latent cancer fatalities for the involved workers.

[Text deleted.]

4.9.1.2 Avoided Air Quality Impacts

Ambient air quality can be affected by emissions of pollutants from the current fuel cycle process and the proposed Pu disposition facilities. The pollutants from the current fuel cycle come from the uranium mining, milling, conversion, and enrichment processes. The pollutant emissions are also from the fossil-fuel power plant that supply the electric power for the current uranium fuel cycle, mainly the uranium enrichment process. By replacing the current fuel cycle with MOX fuel, the uranium fuel enrichment process is eliminated. Thus, the fossil-fuel power that supplies the electric power to the uranium enrichment facility would not be needed. Table 4.9.1.2–1 compares the pollutant air emissions between proposed processes from Pit disassembly/conversion through MOX fuel fabrication and the fossil fuel power plant that supplies the electric power for the current uranium fuel cycle. The comparison shows that pollutant emissions from the current fuel cycle are higher than the potential emissions from the proposed MOX fuel fabrication process.

Table 4.9.1.1–1. Comparison of Radionuclide Atmosphere Emissions

		Emission Rate[a] (Ci/yr)	
Source	Principal Radionuclide	Current Fuel Cycle[b]	MOX Fuel Cycle
Uranium mines	Rn-222	1,200	NA
Uranium mills and mill tailing	Pb-210	$1.3x10^{-2}$	NA
	Po-210	$1.3x10^{-2}$	NA
	Rn-222	752	NA
	Ra-226	$1.3x10^{-2}$	NA
	Th-230	$1.4x10^{-2}$	NA
	U-234	$2.6x10^{-2}$	NA
	U-238	$2.6x10^{-2}$	NA
Uranium conversion	Ra-226	$1.7x10^{-6}$	NA
	Rn-222	0.23	NA
	Th-234	2.1x10-3	NA
	Pa-234m	$2.1x10^{-3}$	NA
	Th-230	$2.4x10^{-5}$	NA
	U-234	$2.1x10^{-3}$	NA
	U-235	$5.1x10^{-5}$	NA
	U-238	$2.1x10^{-3}$	NA
Uranium enrichment	Tc-99	$1.7x10^{-3}$	NA
	U-234	$5.0x10^{-3}$	NA
	U-235	$2.2x10^{-4}$	NA
	U-236	$9.2x10^{-6}$	NA
	U-238	$5.0x10^{-3}$	NA
Pit disassembly/conversion	Pu-238	NA	$4.2x10^{-7}$
	Pu-239	NA	$4.3x10^{-5}$
	Pu-240	NA	$1.0x10^{-5}$
	Pu-241	NA	$3.2x10^{-5}$
	Pu-242	NA	$2.9x10^{-10}$
	Am-241	NA	$1.7x10^{-5}$
Fuel fabrication	U-232	NA	$1.3x10^{-7}$
	U-234	$2.1x10^{-4}$	$3.2x10^{-8}$
	U-235	$7.1x10^{-6}$	$6.2x10^{-10}$
	U-236	$1.1x10^{-5}$	NA
	U-238	$2.7x10^{-5}$	$4.8x10^{-8}$
	Pu-238	NA	$7.9x10^{-7}$
	Pu-239	NA	$2.9x10^{-5}$
	Pu-240	NA	$7.6x10^{-6}$
	Pu-241	NA	$2.7x10^{-5}$
	Pu-242	NA	$1.1x10^{-9}$
	Am-241	NA	$1.4x10^{-7}$

Table 4.9.1.1–1. Comparison of Radionuclide Atmosphere Emissions—Continued

Source	Principal Radionuclide	Emission Rate[a] (Ci/yr) Current Fuel Cycle[b]	MOX Fuel Cycle
Fuel fabrication (continued)	Th-231	$7.1x10^{-6}$	NA
	Th-234	$2.7x10^{-5}$	NA
	Pa-234	$2.7x10^{-5}$	NA

[a] The emissions are based on the assumption that two full MOX core equivalent large LWRs (about 2.0 GWe) are needed for Pu disposition. For the Existing LWR Alternative, it would need three to five existing LWRs. These three to five LWRs would operate with the partial or full MOX core over their operating lifetime, which is equivalent to the two full MOX core LWRs. For the Existing LWR Alternative, for analysis purposes, 70 percent of the surplus Pu was assumed to be used in existing LWRs. As a result, the campaign length would be reduced. However, since the comparison in this table is based on the annual emissions, it is independent of the number of years of operation for the Pu disposition.

[b] The radionuclide emissions given are for the model facilities. The emissions are adjusted according to the 2.0-GWe power output for two large LWRs (EPA 1979a; TTI 1996c).

Note: NA=not applicable.

Source: EPA 1979a; Table M.2.3.1–2.

Table 4.9.1.1–2. Comparison of Potential Radiological Human Health Impacts to the General Public

Fuel Cycle Process	Current Fuel Cycle[a]	MOX Fuel Cycle[a]
Uranium mining (LCF/yr)	$1.2x10^{-2}$	NA
Uranium milling (LCF/yr)	$8.0x10^{-3}$	NA
Uranium conversion (LCF/yr)	$4.6x10^{-4}$	NA
Pit disassembly/conversion[b] (LCF/yr)	NA	$1.5x10^{-7}$-$6.0x10^{-5}$
Fuel fabrication[c] (LCF/yr)	$2.0x10^{-5}$	$7.1x10^{-8}$-$2.4x10^{-5}$
Fuel burning in LWRs[d] (LCF/yr)	$2.0x10^{-5}$-$2.4x10^{-3}$	$2.2x10^{-5}$-$2.0x10^{-3}$
Total (LCF/yr)	$2.1x10^{-2}$-$2.3x10^{-2}$	$2.7x10^{-5}$-$2.1x10^{-3}$
Total (LCF/campaign[e])	0.36-0.39	0.00037-0.036

[a] Ranges of human health impacts in represent the health effects from different sites analyzed in the PEIS. No data for uranium enrichment are presented because of its minimal contribution to health impacts compared to other fuel cycle steps.

[b] See Table 4.3.1.9–1.

[c] See Table 4.3.5.1.9–1 for MOX Fuel Cycle. The LCFs for the current fuel cycle are adjusted for 2 large LWRs for consistency with risk estimators used in this PEIS (EPA 1979a; TTI 1996c).

[d] See Table 4.3.5.2.9–1.

[e] The impacts in this table are based on the assumption that two full core-equivalent large LWRs (about 2.0 GWE) are needed for Pu disposition in 17 years for all surplus Pu. For the Existing LWR Alternative, it would need three to five existing LWRs. These three to five LWRs would operate with the partial MOX core over their operating lifetime, which is equivalent to the two full-core LWRs. For the Existing LWR Alternative, for analysis purposes, 70 percent of the surplus Pu was assumed to be used in existing LWRs. As a result, the campaign length would be reduced.

Note: NA=not applicable.

Table 4.9.1.1–3. Comparison of Potential Radiological Human Health Impacts to Workers

Fuel Cycle Process	Current Fuel Cycle[a]	MOX Fuel Cycle[a]
Uranium mining (LCF/yr)	0.38	NA
Uranium milling (LCF/yr)	0.30	NA
Uranium conversion (LCF/yr)	0.0018	NA
Pit disassembly/conversion[b] (LCF/yr)	NA	0.034
Fuel fabrication[c] (LCF/yr)	0.10	0.012
Fuel burning in LWRs[d] (LCF/yr)	0.14-0.48	0.14-0.48
Total (LCF/yr)	0.92-1.3	0.19-0.53
Total (LCF/campaign)[e]	16-22	3.2-8.9

[a] Ranges of human health impacts represent the health effects from different sites analyzed in the PEIS. No data for uranium enrichment are presented because of its minimal contribution to health impacts compared to other fuel cycle stops.
[b] See Table 4.3.1.9–2.
[c] See Table 4.3.5.1.9–2 for MOX Fuel Cycle. The LCFs for the current fuel cycle are adjusted for 2 large LWRs for consistency with risk estimators used in this PEIS (NRC 1987d; TTI 1996c).
[d] See Table 4.3.5.2.9–2.
[e] The impacts in this table are based on the assumption that two full core-equivalent large LWRs (about 2.0 GWE) are needed for Pu disposition in 17 years for all surplus Pu. For the Existing LWR Alternative, it would need three to five existing LWRs. These three to five LWRs would operate with the partial MOX core over their operating lifetime, which is equivalent to the two full-core LWRs. For the Existing LWR Alternative, for analysis purposes, 70 percent of the surplus Pu was assumed to be used in existing LWRs. As a result, the campaign length would be reduced.
Note: NA=not applicable.

Table 4.9.1.2–1. Comparison of Potential Emission Rates of Criteria Pollutants

Pollutant	Current Fuel Cycle[a] (kg/yr)	MOX Fuel Cycle[b] (kg/yr)
Carbon monoxide (CO)	59,000	NA
Nitrogen dioxide (NO_2)	2,400,000	NA
Ozone (O_3)	NA	NA
Particulate matter (PM_{10})	2,300,000	NA
Sulfur dioxide (SO_2)	8,800,000	NA
Total suspended particulate (TSP)	NA	NA
Volatile organic compounds (VOC)	NA	2,500

[a] The emissions from a supporting coal power plant are derived from the NRC regulations (10 CFR 51 Table S-3). The original numbers in the NRC document are for 1-GWe LWRs. The numbers shown in the table are adjusted for 2-GWe LWRs.
[b] Emissions from the MOX fuel cycle are the sum of the emissions from pit disassembly/conversion and MOX fuel fabrication. See Tables F.1.3–4 and F.1.3–6. The MOX fuel burning in existing LWRs would not cause incremental pollutant air emissions over the current uranium fuel cycle. See Table F.1.3–12.
Note: NA=not available.

4.9.1.3 Other Avoided Environmental Impacts

In addition to reducing potential radiological human health and air quality impacts, fabricating the surplus weapons-usable Pu into MOX fuel for use in existing LWRs would cause other positive environmental impacts. The following positive impacts can be qualitatively stated:

- *Land Resources.* Reduced land disturbance from mining operations.
- *Water Resources.* Reduced impacts to water quality are expected since no mining and mill tailing would be produced, which allows surface runoff or leaching (mine drainage) to occur.

- *Waste Generation.* The total wastes generated by the MOX fueling process (including the pit disassembly/conversion, MOX fuel fabrication, and MOX fuel burning in existing LWRs) would be less than the total wastes generated by the uranium mining, milling, conversion, enrichment, fuel fabrication, and UO_2 fuel burning in existing LWRs.

4.9.1.4 Impacts on Uranium Mining and Nuclear Fuel Cycle Industries

Among the disposition alternatives evaluated in the PEIS, only the reactor alternatives (which would use MOX fuel instead of uranium fuel) could potentially affect the domestic nuclear fuel cycle industry. However, of the four reactor options evaluated in the PEIS (that is, using CANDU reactors, completing a partially built LWR, constructing a new evolutionary LWR, and use of existing LWRs), only using MOX fuel in the existing domestic LWR alternative would likely have any impact on the domestic nuclear fuel cycle industry. By using MOX fuel instead of fuel derived solely from LEU, this reactor alternative could potentially displace some demand for uranium feed products and services.

The CANDU Alternative would have no impact on U.S. uranium and nuclear fuel industries, because Canadian firms currently supply all of the nuclear fuel services and products required by that country's nuclear reactors. Canadian nuclear fuel is derived from Canadian uranium and is converted and fabricated by Canadian companies (CANDU reactors do not require enrichment services). Therefore, the only potential economic impacts would be to Canadian firms rather than U.S. producers. Producing MOX fuel would require significant quantities of depleted uranium, which comprises 97 to 98 percent of MOX feed material. However, the large DOE surplus inventory of depleted uranium would assure that this demand could be easily accommodated.[3]

The construction of an evolutionary LWR or the partially completed LWR could have some impact on the nuclear fuel cycle industries, although the magnitude of the impact would be highly uncertain. The impact from adding a new nuclear reactor as a source of electricity to the national power grid would depend on several factors, including whether:

- The new evolutionary LWR would be supplying power to meet new demand for electricity or supplanting supply from an existing reactor.

- The MOX-fueled plant would otherwise have been a uranium-fueled plant.

If the new power plant were to supplant existing commercial electricity supply from LWRs conventional uranium fuel, then it is possible that uranium demand could decrease. However, this scenario would be unlikely, because during the life cycle of any plant that would be brought on line, many of the currently operating nuclear power plants are expected to be retired. In fact, the EIA projects that between 1994 and 2015, nuclear power generation capacity will decline by 32 percent due to plant retirement. Furthermore, no new reactors are expected to come online before 2015. Electricity demand growth during this period is expected to be met through the construction of new fossil fuel plants, cogeneration, increased energy efficiency, and demand management. Therefore, it is unlikely that the construction of an evolutionary LWR or the completion of a partially built LWR would alter future demand for uranium, uranium enrichment services, or fuel fabrication from the No Action alternative.

The use of MOX fuel in existing domestic nuclear power plants would likely affect the demand for nuclear fuel services. Under this alternative, MOX fuel would be substituted for uranium fuel. If 2 to 3 t (2.2 to 3.3 tons) of Pu (93-percent enriched) per year were converted to MOX fuel and employed in nuclear reactors, approximately 730 to 1,100 t (805 to 1,213 tons) of U_3O_8 would be displaced per year. Because projections indicate that U.S. production of uranium fuel would only supply about 20 percent of domestic needs during the plant's life cycle (2004-2029), much of the impact projected on uranium fuel production would be borne by foreign producers.

[3] DOE is currently developing an EIS for the management of depleted UF_6

Based on current market shares, the MOX fuel could displace from 145 to 218 t/yr (160 to 240 tons/yr) of U.S. uranium oxide production. This compares to EIA projections that domestic uranium oxide production will reach approximately 4,000 t (4,409 tons) in 2005. Although the actual impacts would depend on the state of the uranium market during the nuclear power plant's lifetime, the use of MOX fuel should not have a significant impact on domestic production.

The impacts on uranium conversion, enrichment, and fabrication services would be similar to the impacts on the uranium mining and milling industries. The MOX fuel could displace a small percentage of these services, but the actual impacts are likely to be small. For example, the uranium conversion sector has recently experienced a much stronger market with large price increases over the past few years. This sector is projected to operate at almost full capacity into the foreseeable future. The impacts on the fabrication industry would likewise by small. The throughput rate of 51 to 73 t (56 to 80 tons) of heavy metal per year (depending on the type of reactor used), would represent less than one percent of current U.S. capacity.

It should be noted that the potential impacts described above would occur over the same timeframe as other DOE actions projected to affect the domestic uranium mining and nuclear fuel cycle industries. As, discussed in the HEU Final EIS, the disposition of U.S. surplus HEU and the purchase of Russian surplus HEU are projected to create only small and temporary economic impacts on the domestic uranium mining nuclear fuel cycle industries. Similarly, the sale of surplus natural and LEU currently stored at DOE's gaseous diffusion plants in Piketon, OH and Paducah, KY is expected to have minimal impact on these industries because of the small quantities and the protections provided by the *United States Enrichment Corporation Privatization Act* (DOE 1996s:4-33–4-36). The incremental impacts of using MOX fuel would be small, as would the cumulative impacts of these actions.

4.9.2 USE OF NUCLEAR POWER PLANTS INSTEAD OF FOSSIL FUEL POWER PLANTS

For the proposed Partially Completed and Evolutionary LWR Alternatives, the surplus Pu would be converted to MOX fuel for use in these power plants. Completing or building such nuclear power plants would create net environmental impact over existing conditions. The incremental environmental impacts from the Partially Completed LWR Alternative and the Evolutionary LWR Alternative have been analyzed and presented in Sections 4.3.5.3 and 4.3.5.4, respectively. This section discusses the potential avoided environmental impacts from these two alternatives.

According to the energy consumption projection for the next two decades, 252 gigawatts of new generating capacity will be needed between 1994 and 2015 to satisfy electricity demand and to replace retiring units (EIA 1996a:28). According to the same projection, new power plant constructions will be dominated by coal-fired and natural gas-fired power plants. Although the goal of all alternatives in the Pu disposition program is to dispose of the surplus weapon-usable Pu, the Partially Completed and Evolutionary LWR alternatives do generate electricity. If these alternatives are selected, the required new capacity for the coal-fired or natural gas-fired power plants could be reduced by the same capacity as the partially completed or evolutionary LWR using MOX fuel.

Comparing the coal-fired or natural gas-fired power plants, partially completed or evolutionary LWRs may have positive and negative impacts to the environment. Complete comparisons of the environmental impacts between the proposed partially completed or evolutionary LWRs and the coal-fired or natural gas-fired power plants are beyond the scope of this PEIS. The primary potential avoided impact for these alternatives is the impacts to ambient air quality in the area surrounding the facilities.

Ambient air quality can be affected by emissions of criteria pollutants from the coal-fired and natural gas-fired power plants, and the proposed Pu disposition facilities. More pollutant emissions from a facility poses more environmental impact. Table 4.9.2–1 compares the pollutant air emissions between the MOX fueling process using the partially completed LWR and the fossil fuel power plant that supplies the same amount of the electric power. The MOX fueling process using the Partially Completed LWR Alternative includes pit disassembly/conversion, MOX fuel fabrication, and MOX fuel burning. The comparison shows that almost all criteria pollutant emissions from the coal-fired power plants are much higher than the potential emissions from the proposed partially completed LWR with MOX fuel. Comparing the gas fired power plants, some of pollutants are emitted more from the proposed partially completed LWR using MOX fuel and some pollutants are emitted less. This comparison shows that the impact to the ambient air quality would be reduced if the surplus weapons-usable Pu is utilized as MOX fuel in the partially completed LWR to replace new construction of coal-fired power plants. However, it cannot be concluded that using MOX fuel in partially completed LWRs results in a positive environmental impact over the natural gas-fired power plants.[4]

Table 4.9.2–2 compares the pollutant air emissions between the proposed MOX fueling process using evolutionary LWRs and the fossil fuel power plant that supplies the same amount of the electric power. The MOX fueling process using the evolutionary LWR alternative includes pit disassembly/conversion, MOX fuel fabrication, and MOX fuel burning. The comparison shows that almost all criteria pollutant emissions from the coal-fired power plants are much higher than the potential emissions from evolutionary LWRs using MOX fuel. Comparing the gas-fired power plants, some pollutants are emitted more from evolutionary LWRs with MOX fuel and some pollutants are emitted less. This comparison shows that the impact to the ambient air quality would be reduced if the surplus weapons-usable Pu is utilized as fuel in the evolutionary LWRs to replace new construction of the coal and natural gas power plants.

[4] Use of the partially completed LWR or evolutionary LWR would create additional spent nuclear fuel.

Table 4.9.2–1. Comparison of Potential Emission Rates of Criteria Pollutants Between the Mixed Oxide Fuel Cycle Using Partially Completed Light Water Reactors and Conventional Power Plants

Pollutant	Coal Fired Plant[a] (kg/yr)	Natural Gas Fired Plant[b] (kg/yr)	MOX Fueled Nuclear Plant[c] (kg/yr)
Carbon monoxide	2,800,000	NA	81.6
Nitrogen dioxide	42,000,000	2,000,000	228,000
Ozone	NA	NA	NA
Particulate matter less than or equal to 10 microns in diameter	2,200,000	NA	17,500
Sulfur dioxide	42,000,000	24,000	171,000
Total suspended particulate	2,200,000	NA	17,500
Volatile organic compounds	NA	12,000[d]	2,500

[a] The original numbers in the NRC document are for a 1-GWe LWR (NRC 1987d: Table 17). The numbers shown in the table are adjusted for 2-GWe LWRs.

[b] The natural gas boiler is assumed to be the "controlled-flue gas recirculation" utility type, which has lowest air emissions listed in the EPA report (EPA 1995a).

[c] Emissions from the MOX fuel cycle are the sum of the emissions from the pit disassembly/conversion, MOX fuel fabrication, and the MOX fuel burning in the partially completed LWRs. See Tables F.1.3–4, F.1.3–6, and F.1.3–13.

[d] Organic compounds from the natural gas-fired power plant include methane that comprises 17 percent of organic compounds (EPA 1995a). The VOC value presented here assumes that methane is the only VOC among the organic compounds from the gas fire emissions.

Note: NA=not available.

Table 4.9.2–2. Comparison of Potential Emission Rates of Criteria Pollutants Between the Mixed Oxide Fuel Cycle Using Evolutionary Light Water Reactors and Conventional Power Plants

Pollutant	Coal Fired Plant[a] (kg/yr)	Natural Gas Fired Plant[b] (kg/yr)	MOX Fueled Nuclear Plant[c] (kg/yr)
Carbon monoxide	2,800,000	NA	90
Nitrogen dioxide	42,000,000	2,000,000	5,260
Ozone	NA	NA	NA
Particulate matter less than or equal to 10 microns in diameter	2,200,000	NA	NA
Sulfur dioxide	42,000,000	24,000	900
Total suspended particulate	2,200,000	NA	NA
Volatile organic compounds	NA	12,000[d]	2,500

[a] The original numbers in the NRC document are for a 1-GWe LWR (NRC 1987d, Table 17). The numbers shown in the table are adjusted for 2-GWe LWRs.

[b] The natural gas boiler is assumed to be the "controlled-flue gas recirculation" utility type, which has lowest air emissions listed in the EPA report (EPA 1995a).

[c] Emissions from the MOX fuel cycle are the sum of the emissions from the pit disassembly/conversion, MOX fuel fabrication, and the MOX fuel burning in the evolutionary LWRs. See Tables F.1.3–4, F.1.3–6, and F.1.3–14.

[d] Organic compounds from the natural gas-fired power plant include methane that comprises 17 percent of organic compounds (EPA 1995a). The VOC value presented here assumes that methane is the only VOC among the organic compounds from the gas fire emissions.

Note: NA=not available.

4.10 RELATIONSHIP BETWEEN SHORT-TERM USES OF ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The use of land on any of the six candidate DOE sites being considered for storage and disposition facilities (Hanford, NTS, INEL, Pantex, ORR, and SRS) would enhance the long-term productivity on each site. In light of current reductions in the nuclear weapons stockpile, the lack of new weapons development or production, the moratorium on nuclear testing, and concerns about safety and reliability in the aging stockpile, DOE's Preferred Alternative is to, over time, phase out the RFETS existing storage facility, upgrade the Pantex, ORR, and SRS storage facilities for Pu and HEU storage, and to continue to use existing facilities at Hanford, INEL, and LANL. The reduction of Pu stockpile meets the U.S. nonproliferation policy. In addition, DOE proposes to modify existing or build new disposition facilities that will enhance the long-term use of the selected sites. The Preferred Alternative for disposition is a combination of using pit disassembly/conversion, Pu conversion, MOX fuel fabrication, and immobilization facilities.

Most storage and disposition alternatives would require the use of additional land. Such usage would remove this land from other beneficial uses. Disposal of solid nonhazardous waste generated from facilities construction and operations would require additional land at onsite sanitary landfills. Solid nonhazardous waste generated from these facilities would continuously require additional land at a sanitary landfill site that would be unavailable for other uses in the long term. LLW would require additional space for onsite storage and waste processing and would involve the commitment of associated land, transportation, processing facilities, and other disposal resources. Creation of land disposal facilities allows the site to be productive for the long-term by protecting the overall environment and complying with Federal and State environmental requirements.

Losses of terrestrial and aquatic species and habitats from natural productivity to accommodate new facilities and temporary disturbances required during construction are possible. Land clearing and construction activities resulting in large numbers of personnel and equipment moving about an area would disperse wildlife and temporarily eliminate habitats. Although some destruction would be inevitable during and after construction, these losses would be minimized by careful site selection, including environmental reviews at the site-specific level. In addition, short-term disturbances of previously undisturbed biological habitats from the construction of new facilities could cause long-term reductions in the biological productivity of an area. These long-term effects could occur, for example, at facilities located in arid areas of the western United States such as Hanford, NTS, and INEL, where biological communities recover very slowly from disturbances. Threatened and endangered species would have minimal impacts from the Preferred Alternative.[5]

[5] The range of the threatened desert tortoise lies in the southern third of NTS. Construction and operation of new facilities associated with the storage and disposition facilities have the potential to impact the federally listed threatened desert tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented with mitigation measures developed in consultation with USFWS.

4.11 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

This section describes the major irreversible and irretrievable commitments of resources that can be identified at this programmatic level of analysis. A commitment of resources is irreversible when its primary or secondary impacts limit the future options for a resource. An irretrievable commitment refers to the use or consumption of resources that would be neither renewable nor recoverable for later use by future generations.

The programmatic decisions resulting from this PEIS will commit the resources required for the new construction and renovation of storage and disposition facilities at various locations. This section discusses three major resource categories that would be committed irreversibly or irretrievably to the proposed actions: land, materials, and energy.

Land. Land that is currently occupied by or designated for storage or reactor-related disposition facilities could ultimately be returned to open space if buildings, roads, and other structures were removed, areas were cleaned up, and the land revegetated. Alternatively, some of the facilities could be modified for use in other DOE programs. Therefore, commitment of this land is not necessarily irreversible. However, land rendered unfit for other purposes, such as that set aside for radiological, hazardous and chemical waste disposal facilities or deep borehole emplacement, represents an irreversible commitment because wastes in below-ground disposal areas could not be completely removed nor could the site be feasibly used for any other purposes following closure of disposal or storage facilities. This land would be perpetually unusable because the substrata would not be suitable for potentially intrusive activities such as mining, utilities, or building foundations. However, the surface area appearance and biological habitat lost during construction and operation of the facilities could be restored to a large extent.

Materials. The irreversible and irretrievable commitment of material resources during the entire life-cycle of storage and disposition includes construction materials that could not be recovered or recycled, materials rendered radioactive that could not be decontaminated, and materials consumed or reduced to unrecoverable forms of waste. Where construction is necessary, materials required could include wood, concrete, sand, gravel, plastics, steel, aluminum, and other metals. Construction resources that could not be recovered and recycled with present technology would be irretrievably lost. However, none of these identified construction resources is in short supply, and all would be readily available in the vicinity of the candidate and representative sites.

Materials committed to the manufacture of new equipment that could not be recycled at the end of the project's useful lifetime would be irretrievable. Operating supplies, miscellaneous chemicals, and gases consumed during the operation of long-term storage and disposition facilities, while irretrievable, would not constitute a permanent drain on local resources or involve any material in critically short supply in the United States. Materials consumed or reduced to unrecoverable forms of waste, such as uranium, would also be irretrievably lost. Resources could be recycled. Plans to recover and recycle as much of these valuable, depletable resources as would be practical would depend on the need. Each resource would be individually considered at the time a recovery decision was required. The spent fuel generated by the reactor alternative would not be processed so as to recycle the LEU or Pu.

Energy. The irretrievable commitment of energy resources during construction and operations of the long-term storage and disposition facilities would include the consumption of fossil fuels used to generate heat and electricity for the sites. Energy would also be expended in the form of diesel fuel, gasoline, and oil for construction equipment and transportation vehicles. The energy required to operate the long-term storage and disposition facilities, quantified in the site infrastructure sections previously presented in this chapter, would be irretrievable.

Any decision to dispose of Pu represents an irretrievable commitment of a potential energy source. To protect against proliferation, all disposition alternatives are irreversible and the Pu is lost forever as a fuel resource.

4.12 ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL OF THE VARIOUS ALTERNATIVES AND MITIGATION MEASURES

The proposed long-term storage and disposition alternatives would result in increased energy demands at the affected site or sites during the construction and operation phases. The anticipated energy requirements of all the alternatives would be within the supply capacities of the power grid that would serve its candidate or representative site. Fuel requirements would exceed the current site availability during operation at NTS, Pantex, ORR, and SRS for several of the alternatives, but can be accommodated through normal contractual means. For the Preferred Alternative, additional oil needed at SRS would be required and could be obtained through normal contractual means. Since Hanford, NTS, INEL, and SRS do not use natural gas, the facilities would have to be redesigned to burn fuel oil. Energy requirements would be subject to established conservation practices at the affected site.

Chapter 5
References

ORDERS AND REGULATIONS

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Chapter 7
Glossary of Terms

Absorbed Dose: The energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest in that material. Expressed in units of radiation absorbed dose (rad) or grays, where 1 rad equals 0.01 gray. Also, see "Radiation Absorbed Dose."

Accident Sequence: An initiating event followed by system failures or operator errors, which can result in significant core damage, confinement system failure, and/or radionuclide releases.

Actinides: Radioactive elements with atomic number larger than 88 (that is, 89 or higher)

Action Description Memorandum: A document used in the DOE's NEPA process to facilitate a determination of the appropriate level of NEPA documentation for a proposed action.

Acute: Extremely severe or intense for a limited amount of time.

Acute Exposure: The exposure incurred during and shortly after a radiological release. Generally, the period of acute exposure ends when long-term interdiction is established, as necessary. For convenience, the period of acute exposure is normally assumed to end 1 week after the inception of a radiological accident.

Acute Standard: A numerical limit on the amount of a particular chemical contaminant that an organism may be exposed to over a short period of time.

Air Pollutant: Any substance in air which could, if in high enough concentration, harm man, other animals, vegetation, or material. Pollutants may include almost any natural or artificial composition of matter capable of being airborne.

Air Quality Control Region (AQCR): An interstate area designated by the EPA for the attainment and maintenance of NAAQS.

Air Quality Standards: The level of pollutants in the air prescribed by regulations that may not be exceeded during a specified time in a defined area.

Alloy: A homogeneous mixture of two or more metals.

Alluvial Deposits: Deposits of earth, sand, gravel, and other materials carried by moving surface water and deposited at points of weak water flow.

Alluvium: A general term for all sedimentary accumulations that are deposited by surface water flow. Alluvium includes sediment laid down in riverbeds, flood plains, and alluvial fans.

Alpha Activity: The emission of alpha particles by fissionable materials (uranium or Pu).

Alpha Particle: A positively charged particle, consisting of two protons and two neutrons, that is emitted during radioactive decay from the nucleus of certain nuclides. It is the least penetrating of the three common types of radiation (alpha, beta, and gamma).

Alpha Wastes: Wastes containing radioactive isotopes which decay by producing alpha particles.

Alternative Option: A group of alternative pathways through a different specific set of facilities than that of the baseline or another option.

Ambient Air: The surrounding atmosphere as it exists around people, plants, and structures.

***American Indian Religious Freedom Act* of 1978:** This Act establishes national policy to protect and preserve for Native Americans their inherent right of freedom to believe, express, and exercise their traditional religions, including the rights of access to religious sites, use and possession of sacred objects, and the freedom to worship through traditional ceremonies and rites.

Anadromous: Fish that migrate from salt to fresh water to spawn.

***Anadromous Fish Conservation Act*:** This act seeks to enhance the conservation and development of the anadromous fishery resources of the United States that are subject to depletion from water resources development.

Anhydrous: Without water.

Anisotropic: Conditions where a physical phenomenon is oriented preferentially in a particular direction or on a particular axis. When the groundwater in a region moves north/south faster than it moves east/west, the groundwater movement is anisotropic.

Aquatic Biota: The sum total of living organisms within any designated aquatic area.

Aqueous Process: An operation involving chemicals dissolved in water.

Aquifer: A saturated geologic unit through which significant quantities of water can migrate under natural hydraulic gradients.

Aquitard: A less-permeable geologic unit in a stratigraphic sequence. The unit is not permeable enough to transmit significant quantities of water. Aquitards separate aquifers.

***Archaeological and Historic Preservation Act* of 1974:** This Act is designed to preserve historic and archaeological data that could be destroyed or compromised as the result of Federal construction or other Federally licensed or assisted activities.

***Archaeological Resources Protection Act* of 1979:** This Act serves to protect cultural resources on Federally owned lands. It requires a permit for archaeological excavations or removal of any archaeological resources located on public lands or Native American lands. It prohibits interstate or foreign trafficking of cultural resources taken in violation of state or local laws, and requires Federal agencies to develop plans for surveying lands under their control.

Archaeological Sites: Any location where humans have altered the terrain or discarded artifacts during either prehistoric or historic times.

Artifact: An object produced or shaped by human workmanship of archaeological or historical interest.

As Low as Reasonably Achievable (ALARA): A concept applied to the quantity of radioactivity released in routine operation of a nuclear system or facility, including "anticipated operational occurrences." It takes into account the state of technology, economics of improvements in relation to benefits to public health and safety, and other societal and economic considerations in relation to the use of nuclear energy in the public interest.

Atmospheric Dispersion: The process of air pollutants being dispersed in the atmosphere. This process occurs through wind movement that carries the pollutants away from their source. It is also due to turbulent air motion that results from solar heating of the Earth's surface and air movement over rough terrain and surfaces.

***Atomic Energy Act* (AEA) of 1954:** This Act was originally enacted in 1946 and amended in 1954. For the purpose of this PEIS "...a program for Government control of the possession, use, and production of atomic energy and special nuclear material whether owned by the Government or others, so directed as to make the maximum contribution to the common defense and security and the national welfare, and to provide continued assurance of the Government's ability to enter into and enforce agreements with nations or groups of nations for the control of special nuclear materials and atomic weapons..." (Section 3(c)).

Atomic Energy Commission: A five-member commission, established by the AEA of 1946, to supervise nuclear weapons design, development, manufacturing, maintenance, modification, and dismantlement. In 1974, the AEC was abolished and all functions were transferred to the NRC and the Administrator of the Energy Research and Development Administration. The Energy Research and Development Administration was later terminated and its functions vested by law in the Administrator were transferred to the Secretary of Energy.

Attainment Area: An area considered to have air quality as good as or better than the national ambient air quality standards as defined in the CAA. An area may be an attainment area for one pollutant and a non-attainment area for others.

Attribute: A measurable relevant characteristic of an option, such as public acceptability or technical risk.

Background Radiation: Ionizing radiation present in the environment from cosmic rays and natural sources in the Earth; background radiation varies considerably with location. Also, see "Natural Radiation."

Badged Worker: A worker equipped with an individual dosimeter who has the potential to be exposed to radiation.

***Bald and Golden Eagle Protection Act*:** This act states that it is unlawful to take, pursue, molest, or disturb the American bald and golden eagle, their nests, or their eggs, anywhere in the United States.

Basalt: The most common volcanic rock. Basalt is dark-gray to black in color, high in iron and magnesium, and low in silica. It is typically found in lava flows.

Base Requirement: The nuclear material quantity needed to support the nuclear weapons stockpile (new weapons builds, research and development, and tests) and other needs (nonweapons research and development, isotopic power devices, and commercial sales).

Baseline: A quantitative expression of conditions, costs, schedule, or technical progress to serve as a base or standard for measurement during the performance of an effort; the established plan against which the status of resources and the progress of a project can be measured. For this PEIS, the environmental baseline is the site environmental conditions as they are projected to occur in 2005.

Basin: For geology it is a circular or elliptical downwarp with younger beds in the center after erosion exposes the structure. For topography it is a depression into which the surrounding area drains.

BEIR V: Biological Effects of Ionizing Radiation; referring to the fifth in a series of committee reports from the National Research Council.

Benthic: Plants and animals dwelling at the bottom of oceans, lakes, rivers, and other surface waters.

Best Available Control Technology: A term used in the CAA that means the most stringent level of air pollutant control considering economics for a specific type of source based on demonstrated technology.

Beta Activity: The emission of beta particles by radioisotopes.

Beta Particle: An elementary particle emitted from a nucleus during radioactive decay; it is negatively or positively charged, identical in mass to an electron, and in most cases easily stopped, as by a thin sheet of metal.

Beyond Design Basis Accident: An accident, generally with more severe impacts to onsite personnel and the public than a DBA, initiated by operational or external causes with an estimated probability of occurrence less than 10^{-6} per year and used for estimating the impacts of a facility and/or process.

Biofouling: Aquatic organisms such as bacteria, fungi, algae, and mollusks, that colonize in waterflow structures (for example, cooling water systems of power plants/reactors), often causing restricted water flow.

Biological Dose: The radiation dose absorbed in biological material measured in rem or millirem (one-thousandth of a rem).

Biota (Biotic): The plant and animal life of a region.

Biotic Resources: Biotic resources include terrestrial resources, wetlands, and aquatic resources, and threatened and endangered species.

Boiling Water Reactor (BWR): A type of nuclear reactor that uses fission heat to generate steam in the reactor to drive turbines and generate electricity.

Borehole: A deep hole drilled below the water table and at least 2 km (1.2 mi) deep into ancient, geologically stable rock formations.

Bryozoa: A phylum consisting of various small aquatic animals that reproduce by budding and form colonies attached to stones or seaweed.

Burn: To consume in a reactor through fission.

Burnable Poison Rod: A nuclear reactor rod used to absorb excess neutrons in the core during the early core life. As the core life proceeds, the absorbing material is depleted ("burned"), reducing the absorptive power concurrent with the reduction in excess neutron production.

Calcareous: Containing calcium carbonate (for example, calcite or limestone).

Calcination: The process of converting high-level waste to unconsolidated granules or powder. Calcined solid wastes are primarily salts and oxides of metals (heavy metals) and components of high level waste (also called calcining).

Calcine: Drying of liquids or other material at high temperature (approximately 800° C) to drive off water and other volatile substances.

Caldera: A large crater formed by the collapse of the central part of a volcano.

Cancer: The name given to a group of diseases characterized by uncontrolled cellular growth with cells having invasive characteristics such that the disease can transfer from one organ to another.

Canadian Deuterium Uranium (CANDU) Reactor: A nuclear reactor in which circulating heavy water is used to cool the reactor core and to moderate (reduce the energy of) the neutrons created in the core by the fission reactions.

Canyon: A remotely operated, heavily shielded Pu or uranium processing facility.

Capable Fault: As defined in 10 CFR 100, Appendix A, III (g), a fault that has exhibited one or more of the following characteristics: (1) Movement at or near the ground surface at least once within the past 35,000 years or movement of a recurring nature within the past 500,000 years; (2) Macro-seismicity instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the fault; (3) A structural relationship to a capable fault according to characteristics (1) or (2) such that movement on one could be reasonably expected to be accompanied by movement on the other. Notwithstanding the above, structural association of a fault with geologic structural features that are at least pre-Quarternary in use, in the absence of conflicting evidence, demonstrates that the fault is not a capable fault within this definition.

Capacity Factor: The ratio of the annual power production of a power plant to its rated capacity.

Carbon Adsorption: A physiochemical process in which organic and certain inorganic compounds in a liquid stream are absorbed on a bed of activated carbon; used in water or waste purification and chemical processing.

Carbon Dioxide (CO_2): A colorless, odorless, nonpoisonous gas that is a normal component of the ambient air; it is an expiration product of normal animal life.

Carbon Monoxide (CO): A colorless, odorless gas that is toxic if breathed in high concentration over a period of time.

Carolina Bay: Ovate, intermittently flooded depression of a type occurring on the Coastal Plain from New Jersey to Florida.

Cask (Radioactive Materials): A container that meets all applicable regulatory requirements for shipping spent nuclear fuel or HLW.

Cenozoic Era: A geologic era characterized by the dominance of advanced mollusks and mammals. The Cenozoic Era dates from 65 million years ago to the present.

Ceramic: For this PEIS, surplus Pu and other materials mixed to form a porcelain end product which has mineral phases similar to Synroc-C.

Cesium (Cs): A silver-white alkali metal. A radioactive isotope of cesium, Cs-137, is a common fission product.

Chemical Oxygen Demand: A measure of the quantity of chemically oxidizable components present in water.

Chronic: Lasting for a long period of time or marked by frequent recurrence.

Chronic Exposure: Low-level radiation exposure incurred over a long time period due to residual contamination.

Chronic Standard: A numerical limit on the amount of a particular chemical contaminant that an organism may be exposed to over an extended period of time. The allowable exposure concentration for the chronic standard is less than that of the acute standard.

Cladding: An external layer of material applied directly to nuclear fuel or other material to provide protection from a chemically reactive environment, to provide containment of radioactive products produced during the irradiation of the composite, or to provide structural support.

***Clean Air Act* (CAA):** This Act mandates and enforces air pollutant emissions standards for stationary sources and motor vehicles.

***Clean Air Act Amendments* of 1990:** Expands the EPA's enforcement powers and adds restrictions on air toxics, ozone depleting chemicals, stationary and mobile emissions sources, and emissions implicated in acid rain and global warming.

***Clean Water Act* (CWA) of 1972, 1987:** This Act regulates the discharge of pollutants from a point source into navigable waters of the United States in compliance with a NPDES permit as well as regulates discharges of dredge or fill material to waters of the United States including wetlands.

Climatology: The science that deals with climates and investigates their phenomena and causes.

Code of Federal Regulations (CFR): All Federal regulations in force are published in codified form in the CFR.

Cold Standby: Maintenance of a protected reactor condition in which the fuel is removed, the moderator is stored in tanks, and equipment and system layup is performed to prevent deterioration, such that future refueling and restart are possible.

Coliform: Normally harmless types of bacteria that reside in the intestinal tract of humans and other animals whose presence in water is an indicator that the water may be contaminated with other disease-causing organisms found in untreated human and animal waste.

Collapse Depression: A depression formed when underground lava or gases move or escape (for example, in an eruption) and the ground above collapses.

Collected Dose Equivalent: The sum of per capita dose equivalents for a given organ over the number of exposed individuals.

Collective Committed Effective Dose Equivalent: The committed effective dose equivalent of radiation for a population.

Committed Effective Dose Equivalent: The predicted total dose equivalent to a tissue or organ over a 50-year period after an intake of radionuclide into the body. It does not include external dose contributions. Committed dose equivalent is expressed in units of rem or Sievert. The committed effective dose equivalent is the sum of the committed dose equivalents to the various tissues of the body, each multiplied by the appropriate weighting factor.

Community (Biotic): All plants and animals occupying a specific area under relatively similar conditions.

Complex: The Nuclear Weapons Complex, which is a set of Federal sites and government-owned/ contractor-operated facilities administered by DOE.

Compound (Other Than Oxides): Fluorides, carbides, chlorides, and other materials containing less than 50 percent impurities of Pu that may require chemical processing for some disposition options.

Comprehensive Environmental Response, Compensation, and Liability Act **(CERCLA) of 1980 (Superfund):** This Act provides a regulatory framework for remediation of past contamination from hazardous waste. If a site meets the Act's requirements for designation, it is ranked along with other "Superfund" sites and is listed on the NPL. This ranking is the EPA's way of determining which sites have the highest priority for cleanup.

Conceptual Design: Efforts to develop a project scope that will satisfy program needs; ensure project feasibility and attainable performance levels for congressional consideration; develop project criteria and design parameters for all engineering disciplines; and identify applicable codes and standards, quality assurance requirements, environmental studies, construction materials, space allowances, energy conservation features, health, safety, safeguards, security requirements, and any other features or requirements necessary to describe the project.

Confined Aquifer: A permeable geological unit containing water that is at a pressure higher than atmospheric pressure. It is bounded above and below by aquitards.

Consumptive Water Use: The difference in the volume of water withdrawn from a body of water and the amount released back into the body of water.

Container: The metal envelope in the waste package that provides the primary containment function of the waste package and is designed to meet the containment requirements of 10 CFR 60.

Control Rods: The elements of a nuclear reactor that absorb slow neutrons and are used to increase, decrease, or maintain the neutron density in the reactor.

Conversion: An operation for changing material from one form, use, or purpose to another.

Coolant: A substance, either gas or liquid, circulated through a nuclear reactor or processing plant to remove heat.

Cosmic Radiation: Streams of highly penetrating, charged particles, composed of protons, alpha particles, and a few heavier nuclei, that bombard the earth from outer space.

Counter-proliferation: The activities of the DoD across the full range of U.S. efforts to combat proliferation, including diplomacy, arms control, export controls, and intelligence collection and analysis, with particular responsibility for assuring that U.S. forces and interests can be protected should they confront an adversary armed with weapons of mass destruction or missiles.

Credible Accident: An accident that has a probability of occurrence greater than or equal to one in a million years.

Cretaceous: The geologic period making up the end of the Mesozoic Era, dating from approximately 144 million to 66 million years ago.

Criteria Pollutants: Six air pollutants for which national ambient air quality standards are established by EPA: sulfur dioxide, nitric oxides, carbon monoxide, ozone, particulate matter less than or equal to 10 microns in diameter, and lead.

Critical Action: Any activity for which even a slight chance of flooding would be too great; such actions may include the storage of highly volatile, toxic, or water reactor materials (10 CFR 1022).

Critical Habitat: Defined in the *Endangered Species Act* of 1973 as "specific areas within the geographical area occupied by [an endangered or threatened] species..., essential to the conservation of the species and which may require special management considerations or protection; and specific areas outside the geographical area occupied by the species... that are essential for the conservation of the species."

Critical Mass: The smallest mass of fissionable material that will support a self-sustaining nuclear chain reaction under specified conditions.

Criticality: A state in which a self-sustaining nuclear chain reaction is achieved.

Crystalline Rock: Rock consisting of minerals in a crystalline state.

Cultural Resources: Archaeological sites, architectural features, traditional use areas, and Native American sacred sites.

Cumulative Impacts: The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal), private industry, or individual undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7.)

Curie: A unit of radioactivity equal to 37 billion disintegrations per second; also a quantity of any nuclide or mixture of nuclides having 1 curie of radioactivity.

Decay (Radioactive): The decrease in the amount of any radioactive material with the passage of time, due to the spontaneous transformation of an unstable nuclide into a different nuclide or into a different energy state of the same nuclide; the emission of nuclear radiation (alpha, beta, or gamma radiation) is part of the process.

Decay Heat (Radioactivity): The heat produced by the decay of certain radionuclides.

Decibel (dB): A unit of sound measurement. In general, a sound increases in loudness by a factor of 10 for every increase of 10 decibels.

Decibel, A-weighted (dBA): A unit of weighted sound pressure level, measured by the use of a metering characteristic and the "A" weighting specified by the ANSI S1.4-1971(R176), that refers to the effect on humans.

Decontamination: The removal of radioactive or chemical contamination from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

Demilitarization: An irreversible modification or destruction of a weapons component or part of a component to the extent required to prevent use in its original weapon purpose.

Demography: The statistical study of human populations, including size, density, distribution, and such vital statistics as age, sex, and ethnicity.

Depleted Uranium: Uranium whose content of the isotope U-235 is less than 0.7 percent, which is the U-235 content of naturally occurring uranium.

Deposition: In geology, the laying down of potential rock-forming materials; sedimentation. In atmospheric transport, the settling out on ground and building surfaces of atmospheric aerosols and particles ("dry deposition") or their removal from the air to the ground by precipitation ("wet deposition" or "rainout").

Derived Concentration Guide (DCG): The concentration of a radionuclide in air or water which, under conditions of continuous exposure by one exposure mode (that is, ingestion of water or submersion or inhalation of air) for one year, a "reference man" would receive the most restrictive of (1) an effective dose equivalent of 100 mrem or (2) a dose equivalent of 5 rem to any tissues, including skin and lens of the eye.

Design Basis: For nuclear facilities, information that identifies the specific functions to be performed by a structure, system, or component and the specific values (or ranges of values) chosen for controlling parameters for reference bounds for design. These values may be: (1) restraints derived from generally accepted state-of-the-art practices for achieving functional goals; (2) requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which a structure, system, or component must meet its functional goals; or (3) requirements derived from Federal safety objectives, principles, goals, or requirements.

Design-Basis Accident (DBA): For nuclear facilities, a postulated abnormal event that is used to establish the performance requirements of structures, systems, and components that are necessary to (1) maintain them in a safe shutdown condition indefinitely or (2) prevent or mitigate the consequences of the design-basis accident so that the general public and operating staff are not exposed to radiation in excess of appropriate guideline values.

Design-Basis Events: Postulated disturbances in process variables that can potentially lead to design-basis accidents.

Design Laboratory: A DOE facility involved in the design of nuclear weapons.

Detritus: Dead organic material and organisms.

Deuterium: A nonradioactive isotope of the element hydrogen with one neutron and one proton in the atomic nucleus.

Deuterium Oxide: See "Heavy Water."

[Text deleted.]

Dip: The acute angle that a structural surface (for example, a bedding or fault plane) in a geologic material makes with the horizontal, measured perpendicular to the strike of the surface. Updip is at a higher elevation on the surface.

Direct Economic Effects: The initial increases in output from different sectors of the economy resulting from some new activity within a predefined geographic region.

Direct Jobs: The number of workers required at a site to implement an alternative.

Discard: To dispose of material as waste.

Dismantlement: The process of taking apart a nuclear warhead and removing the subassemblies, components, and individual parts.

Disposal: The process of placing waste in a final repository.

Disposition: A process of use or disposal of materials that results in the remaining material being converted to a form that is substantially and inherently more proliferation-resistant than the original form.

Dissolution: The chemical dispersal of a solid throughout a liquid medium.

Dolomite: A mineral composed of calcium magnesium carbonate ($CaMg(CO_3)_2$) and the chief constituent in the rock also commonly called dolomite and of some kinds of marble.

Dome: For geology it is a circular or elliptical uplift with older beds in the center whose beds dip away in all directions from a central area. For topography it is any dome-shaped rock mass.

Dose: The energy imparted to matter by ionizing radiation. The unit of absorbed dose is the rad or gray.

Dose Commitment: The dose an organ or tissue would receive during a specified period of time (for example, 50 to 100 years) as a result of intake (by ingestion or inhalation) of one or more radionuclides from a defined release, frequently over a year's time.

Dose Equivalent: The product of absorbed dose in rad or gray and the effect of this type of radiation in tissue and a quality factor. Dose equivalent is expressed in units of rem or Sievert, where 1 rem equals 0.01 Sievert. The dose equivalent to an organ, tissue, or the whole body will be that received from the direct exposure plus the 50-year committed dose equivalent received from the radionuclides taken into the body during the year.

Dosimeter: A small device or instrument (for example, film badge or ionization chamber) carried by a radiation worker that measures cumulative radiation dose.

Drainage Basin: An above ground area that supplies the water to a particular stream.

Drawdown: The height difference between the natural water level in an aquifer and the reduced water level in the formation caused by the withdrawal of groundwater.

Drift: Effluent mist or spray carried into the atmosphere from cooling towers.

Drinking-Water Standards: The prescribed level of constituents or characteristics in a drinking water supply that cannot be exceeded legally.

Dry Site: For the purpose of this PEIS any site where adequate surface water is not abundantly available for storage and disposition needs. At such sites, groundwater is used for water supply.

Effective Dose Equivalent: The summation of the products of the dose equivalent received by specified tissues of the body and a tissue-specific weighting factor. This sum is a risk-equivalent value and can be used to estimate the health effects risk of the exposed individual. The tissue-specific weighting factor represents the fraction of the total health risk resulting from uniform whole-body irradiation that would be contributed by that particular tissue. The effective dose equivalent includes the committed effective dose equivalent from internal deposition of radionuclides, and the effective dose equivalent due to penetrating radiation from sources external to the body. Effective dose equivalent is expressed in units of rem or Sievert.

[Text deleted.]

Effluent: A gas or fluid discharged into the environment.

Emergency Condition: For a nuclear facility, occurrences or accidents that might occur infrequently during start-up testing or operation of the facility. Equipment, components, and structures might be deformed by these conditions to the extent that repair is required prior to reuse.

Emission Standards: Legally enforceable limits on the quantities and/or kinds of air contaminants that can be emitted into the atmosphere.

Empirical: Something that is based on actual measurement, observation, or experience rather than on theory.

Endangered Species: Defined in the ESA of 1973 as "any species which is in danger of extinction throughout all or a significant part of its ranges."

***Endangered Species Act* (ESA) of 1973:** This Act requires Federal agencies, with the consultation and assistance of the Secretaries of the Interior and Commerce, to ensure that their actions will not likely jeopardize the continued existence of any endangered or threatened species or adversely affect the habitat of such species.

Engineered Safety Features: For a nuclear facility, features that prevent, limit, or mitigate the release of radioactive material from its primary containment.

Entrainment: The involuntary capture and inclusion of organisms in streams of flowing water, a term often applied to the cooling water systems of power plants/reactors. The organisms involved may include phyto- and zooplankton, fish eggs and larvae (ichthyoplankton), shellfish larvae, and other forms of aquatic life.

Environment, Safety, and Health (ES&H) Program: In the context of DOE, encompasses those DOE requirements, activities, and functions in the conduct of all DOE and DOE-controlled operations that are concerned with: impacts to the biosphere; compliance with environmental laws, regulations, and standards controlling air, water, and soil pollution; limiting the risks to the well-being of both operating personnel and the general public to acceptably low levels; and protecting property adequately against accidental loss and damage. Typical activities and functions related to this program include, but are not limited to, environmental protection, occupational safety, fire protection, industrial hygiene, health physics, occupational medicine, and process and facilities safety, nuclear safety, emergency preparedness, quality assurance, and radioactive and hazardous waste management.

Environmental Assessment (EA): A written environmental analysis that is prepared pursuant to NEPA to determine whether a Federal action would significantly affect the environment and thus require preparation of a more detailed EIS. If the action does not significantly affect the environment, then a FONSI is prepared.

Environmental Audit: A documented assessment of a facility to monitor the progress of necessary corrective actions, to ensure compliance with environmental laws and regulations, and to evaluate field organization practices and procedures.

Environmental Documentation: Documents describing information and results from studies and evaluations required by NEPA. This documentation includes both an EA and an EIS.

Environmental Impact Statement (EIS): A document required of Federal agencies by NEPA for major proposals or legislation significantly affecting the environment. A tool for decisionmaking, it describes the positive and negative effects of the undertaking and alternative actions.

Environmental Justice: The fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment implies that no population of people should be forced to shoulder a disproportionate share of the negative environmental impacts of pollution or environmental hazards due to a lack of political or economic strength.

Environmental Survey: A documented, multidisciplined assessment (with sampling and analysis) of a facility to determine environmental conditions and to identify environmental problems requiring corrective action.

Eocene: A geologic epoch early in the Cenozoic Era, dating from approximately 54 to 38 million years ago.

Ephemeral Stream: A stream that flows intermittently, typically only after periods of heavy precipitation.

Epicenter: The point on the Earth's surface directly above the focus of an earthquake.

Epidemiology: The science concerned with the study of events that determine and influence the frequency and distribution of disease, injury, and other health-related events and their causes in a defined human population.

Equivalent Sound (Pressure) Level: The equivalent steady sound level that, if continuous during a specified time period, would contain the same total energy as the actual time-varying sound. For example, L_{eq} (1-h) and L_{eq} (24-h) are the 1-hour and 24-hour equivalent sound levels, respectively.

Estuary: A thin zone along a coastline where fresh water from rivers mixes with salty ocean waters that provides aquatic habitats with a lower average salinity (salt concentration) than ocean waters. Three-fourths of the commercially important aquatic animal species in the United States spend all or part of their life in estuaries and coastal wetlands.

Evaluation Basis Accident: An accident generally with small impacts to the public, initiated by operational or external causes with an estimated probability of occurrence greater than 10^{-6} per year and used for estimating the impacts of a planned new or modified facility, and/or process when a Safety Analysis Report, that would define a DBA, has not been prepared. A DBA is used to establish the performance requirements of structures, systems, and components that are necessary to maintain them in a safe shutdown condition indefinitely or to prevent or mitigate the consequences of the DBA so that the public and onsite personnel are not exposed to radiation in excess of appropriate guidelines values.

Executive Order 12372, Intergovernmental Review of Federal Programs: The Order directs Federal agencies to consult with and solicit input from state and local governments whose jurisdictions would be affected by Federal actions.

Exposure Limit: The level of exposure to a hazardous chemical (set by law or a standard) at which or below which adverse human health effects are not expected to occur:

- Reference dose is the chronic exposure dose (mg/kg/day) for a given hazardous chemical at which or below which adverse human non-cancer health effects are not expected to occur.

- Reference concentration is the chronic exposure concentration (mg/m^3) for a given hazardous chemical at which or below which adverse human non-cancer health effects are not expected to occur.

***Farmland Protection Policy Act*:** The purpose of the Act is to reduce the conversion of farmland to nonagricultural uses by Federal projects and programs. The Act requires that Federal agencies comply to the fullest extent possible with state and local government policies to preserve farmland. Specifically, the Act advises that evaluations and analyses of prospective farmland conversion impacts be made early in the planning process before a site or design is selected and that, where possible, agencies make such evaluations and analyses part of the NEPA process.

Fast Reactor: A fast reactor does not contain a moderator to slow down neutrons after they are generated. It is distinguished from a fast breeder reactor by not necessarily producing more fuel than it consumes.

Fault: A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred. A normal fault occurs when the hanging wall has been depressed in relation to the footwall. A reverse fault occurs when the hanging wall has been raised in relation to the footwall. A thrust fault is a low-angle (dip less than about 30 degrees) reverse fault.

Fault-plane: A fault surface that is more or less flat or level.

Fauna: Animals, especially those of a specific region, considered as a group.

***Federal Land Policy and Management Act*:** This act states that all public lands would be retained in Federal ownership unless it is determined that another use would better serve the interests of the nation. Specifically, the Act addresses land retained in public-domain status, land withdrawn from the public domain for use by a Federal agency, land to be returned to the public domain, or public land identified for disposal. Additionally, the Act requires that public lands be managed in a manner that would protect the quality of its scientific, scenic, historical, ecological, and environmental aspects; and that public lands and their resources be inventoried periodically and systematically.

Finding of No Significant Impact (FONSI): A document by a Federal agency briefly presenting the reasons why an action, not otherwise excluded, will not have a significant effect on the human environment and will not require an EIS.

Fissile: The term "fissile" refers to nuclear materials that are fissionable by slow (thermal) neutrons. Fissile materials include U-235, U-233, Pu-239, and Pu-241. Materials such as U-238 and Th-232, which can be converted into fissile materials, are called fertile materials. It should be noted that Th-232, U-238 and all Pu isotopes are fissionable by fast neutrons but not by thermal (slow) neutrons. They are not called fissile materials but may be called fissionable materials.

Fissile Material: Pu-239, Pu-241, U-233, U-235, or any material containing any of the foregoing.

Fission: The splitting of a heavy atomic nucleus into at least two nuclei of lighter elements, accompanied by the release of energy and generally one or more neutrons. Fission can occur spontaneously or be induced by neutron bombardment.

Fission Products: Nuclei formed by the fission of heavy elements (primary fission products); also, the nuclei formed by the decay of the primary fission products, many of which are radioactive.

Fissionable Material: Material whose nuclei fission when bombarded by neutrons.

Fissure: A long and narrow crack in the earth.

Floodplain: The lowlands adjoining inland and coastal waters and relatively flat areas including at a minimum that area inundated by a 1-percent or greater chance flood in any given year. The base floodplain is defined as the 100-year (1.0 percent) floodplain. The critical action floodplain is defined as the 500-year (0.2 percent) floodplain.

Flora: Plants, especially those of a specific region, considered as a group.

Footwall: The mass of rock beneath a fault plane.

Formation: In geology, the primary unit of formal stratigraphic mapping or description. Most formations possess certain distinctive features.

Fossil: Impression or trace of an animal or plant of past geological ages that has been preserved in the earth's crust.

Fossiliferous: Containing a relatively large number of fossils.

Frit: Finely ground glass used as feedstock input for vitrification.

Fuel-Grade Material: Pu and HEU, in various forms (for example, metals and oxides), that can be used in experimental and research reactors. Fuel grade Pu contains between 7 to 19 percent Pu-240.

Fugitive Emissions: Emissions to the atmosphere from pumps, valves, flanges, seals, and other process points not vented through a stack. Also includes emissions from area sources such as ponds, lagoons, landfills, and piles of stored material.

Gamma Radiation: Short-wavelength electromagnetic radiation of nuclear origin, similar to, but with higher energy than, x rays.

Gamma Rays: High-energy, short-wavelength, electromagnetic radiation accompanying fission and emitted from the nucleus of an atom. Gamma rays are very penetrating and can be stopped only by dense materials (such as lead) or a thick layer of shielding materials.

Gaussian Plume: The distribution of material (a plume) in the atmosphere resulting from the release of pollutants from a stack or other source. The distribution of concentrations about the centerline of the plume, which is assumed to decrease as a function of its distance from the source and centerline (Gaussian distribution), depends on the mean wind speed and atmospheric stability.

Genetic Effects: The outcome resulting from exposure to mutagenic chemicals or radiation which results in genetic changes in germ line or somatic cells.

- Effects on genetic material in germ line (sex cells) cause trait modifications that can be passed from parents to offspring.

- Effects on genetic material in somatic cells result in tissue or organ modifications (for example, liver tumors) that do not pass from parents to offspring.

Geologic Repository (Mined Geologic Repository): A HLW repository pursuant to the NWPA as amended, for the disposal of nuclear waste; the waste is isolated by placement in a continuous, stable geologic formation at depths greater than 300 m (984 ft).

Geology: The science that deals with the study of the Earth: the materials, processes, environments, and history of the planet, including the rocks and their formation and structure.

Gigawatt Electric: A gigawatt electric is equal to one thousand MWe or one billion watts of electric power.

Glass: Borosilicate material in an amorphous mixture formed by melting silica and boric oxide together with the oxides of elements such as sodium.

Global Commons: Resources not yet allocated to national states. Resources primarily include oceans and outer space. The inclusion of Antarctica as a "Global Commons" area is controversial, and no professional consensus has been determined.

Glove Box: An airtight box used to work with hazardous material, vented to a closed filtering system, having gloves attached inside of the box to protect the worker.

Ground Shine: An area on the ground where radioactivity has been deposited by a radioactive plume or cloud.

Groundwater: The supply of water found beneath the Earth's surface, usually in aquifers, which may supply wells and springs.

Guideline Level: A suggested, desired level of concentration. It is not a regulatory value, but is a value offered as desirable by an agency to protect human health or the environment.

Half-life (Radiological): The time in which half the atoms of a radioactive substance decays to another nuclear form; this varies for specific radioisotopes from millionths of a second to billions of years.

Hazard Index (HI): A summation of the HQ for all chemicals now being used at a site and those proposed to be added to yield cumulative levels for a site. A HI value of 1.0 or less means that no adverse human health effects (non-cancer) are expected to occur.

Hazard Quotient (HQ): The value used as an assessment of non-cancer associated toxic effects of chemicals, (for example, kidney or liver dysfunction). It is independent of a cancer risk, which is calculated only for those chemicals identified as carcinogens.

Hazardous Material: A material, including a hazardous substance, as defined by 49 CFR 171.8 which poses a risk to health, safety, and property when transported or handled.

Hazardous/Toxic Waste: Any solid waste (can also be semisolid or liquid, or contain gaseous material) having the characteristics of ignitability, corrosivity, toxicity, or reactivity, defined by RCRA and identified or listed in 40 CFR 261 or by TSCA.

Heat Exchanger: A device that transfers heat from one fluid (liquid or gas) to another.

Heavy Metals: Metallic or semimetallic elements of high molecular weight, such as mercury, chromium, cadmium, lead, and arsenic, that are toxic to plants and animals at known concentrations.

Heavy Water: A form of water (a molecule with two hydrogen atoms and one oxygen atom) in which the hydrogen atoms consist largely or completely of the deuterium isotope. Heavy water has almost identical chemical properties, but quite different nuclear properties, as light water (common water).

Hemi-shells: Product that results when a pit is divided into two half pieces.

High Efficiency Particulate Air (HEPA) Filter: A filter used to remove particulates from dry gaseous effluent streams.

High-Level Waste (HLW): The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid. HLW contains a combination of transuranic waste and fission products in concentrations requiring permanent isolation.

Highly Enriched Uranium (HEU): Uranium enriched in isotope U-235 to 20 percent or above, which becomes suitable for weapons use.

Historic Resources: In the United States, (that is, archaeological sites), architectural structures, and objects produced from 1492 on, after the arrival of the first Europeans to the Americas.

Holocene: The current epoch of geologic time, which began approximately 10,000 years ago.

Hydraulic Conductivity: The constant of proportionality in Darcy's Law of fluid flow that describes the ease with which a porous medium permits fluids to flow and the ease with which the fluid flows given its physical properties.

[Text deleted.]

Hygroscopic: Capable of absorbing and retaining moisture.

Igneous Rock: Rock originally formed by the cooling and consolidation of magma (molten silicate minerals) including volcanic rocks and plutonic rocks.

Immersion Dose: Dose resulting from being surrounded by a medium (air or water) that contains radionuclides.

Immobilization: A process that converts Pu to a chemically stable form for disposal.

Impingement: The process by which aquatic organisms too large to pass through the screens of a water intake structure become caught on the screens and are unable to escape.

Impoundment: A collection area for water, usually for irrigation purposes.

Incident-Free Risk: The radiological or chemical impacts resulting from packages aboard vehicles in normal transport. This includes the radiation or hazardous chemical exposure of specific population groups such as crew, passengers, and bystanders.

Indirect Economic Effects: Indirect effects result from the need to supply industries experiencing direct economic effects with additional outputs to allow them to increase their production. The additional output from each directly affected industry requires inputs from other industries within a region (that is, purchases of goods and services). This results in a multiplier effect to show the change in total economic activity resulting from a new activity in a region.

Indirect Jobs: Within an REA, jobs generated or lost in related industries as a result of a change in direct employment.

Infrastructure: The basic facilities, services, and installations needed for the functioning of a plant or other site, such as transportation and communication systems.

Injection Well: A well that transfers water from the surface into the ground, either through gravity or by mechanical means.

Interbedded: Occurring between beds or lying in a bed parallel to other beds of a different material.

Interfluvial: Falling in the area between two streams.

Interim (Permit) Status: Period during which treatment, storage, and disposal facilities coming under RCRA are temporarily permitted to operate while awaiting denial or issuance of a permanent permit.

Interim Storage: Providing safe and secure capacity in the near term to support continuing operations in the interim period until long-term storage or disposition actions are implemented.

Ion Exchange: A physiochemical process that removes anions and cations, including radionuclides, from liquid streams (usually water) for the purpose of purification or decontamination.

Ionizing Radiation: Radiation that can displace electrons from atoms or molecules, thereby producing ions.

Isotope: An atom of an element with a specific atomic number and atomic mass. Isotopes of the same element have the same number of protons (atomic number) but different numbers of neutrons and different atomic masses.

Joule: A metric unit of energy, work, or heat, equivalent to 1 watt-second, 0.737 foot-pound, or 0.239 calories.

Jurassic: The middle period of the Mesozoic Era, dating from 208 million to 144 million years ago.

Karst Terrain: A type of land surface that is found in regions underlain by soluble rocks, such as limestone and dolomite, which is peculiar to and dependent upon underground solution of the bedrock and the diversion of surface waters to underground waters (that is, streams that disappear underground). Karst terrain is characterized by sinkholes, underground streams, and caves.

Lacustrine Wetland: Lakes, ponds, and other enclosed open waters at least 8 ha (20 acres) in extent and not dominated by trees, shrubs, and emergent vegetation.

Lag Storage: Temporary storage at a disposition facility.

Land Resources: Land resources are comprised of all of the terrestrial areas available for economic production, residential or recreational use, Government activities (such as military bases), or natural resources consumption. The patterns and densities of land use and the quality of visual resources are evaluated under land resources.

Land Use: The characterization of land in terms of the use potential of the land's surface for the location of various activities.

Landscape Character: The arrangement of a particular landscape as formed by the variety and intensity of the landscape features (land, water, vegetation, and structures) and the four basic elements (form, line, color, and texture). These factors give an area a distinctive quality that distinguishes it from its immediate surroundings.

Large Release: A release of radioactive material that would result in doses greater than 25 rem to the whole body or 300 rem to the thyroid at 1.6 km (1 mi) from the control perimeter (security fence) of a reactor facility.

Latent Fatalities: Fatalities associated with acute and chronic environmental exposures to chemical or radiation that occur within 30 years of exposure.

Lava Tube: A hollow space beneath the surface of a solidified lava flow, formed by the withdrawal of molten lava after the formation of the surficial crust.

Light Water: The common form of water (a molecule with two hydrogen atoms and one oxygen atom) in which the hydrogen atom consists largely or completely of the normal hydrogen isotope (one proton).

Light Water Reactor: There are two types of light water reactors. One is a pressurized water reactor and the other is a boiling water reactor. Both are thermal reactors in which circulating light water is used to cool the reactor core and to moderate (reduce the energy of) the neutrons created in the core by the fission reactions. All commercially operating reactors in the United States and most commercial reactors worldwide are LWRs.

Light Water Reactor (MOX Fuel): An LWR with full MOX fuel is fueled with fuel rods each containing a mixture or blend of uranium oxide and plutonium oxide. Traditional programs of using Pu in LWRs start with a partial core, not full core of MOX fuel.

Limited-lifetime Component: A weapon component that decays with age and must be replaced periodically.

Lithic: Pertaining to stone or a stone tool.

Lithic Scatter: An archaeological site consisting of stone artifacts and by-products of their manufacture and maintenance.

Lithologic: Pertaining to the structure and composition of a rock.

Long-Lived Radionuclides: Radioactive isotopes with half-lives greater than about 30 years.

Low-Enriched Uranium (LEU): Naturally occurring uranium contains only about 0.7 percent U-235 and almost all of the rest is U-238. Low-enriched uranium is enriched in the isotopic content of U-235, greater than 0.7 percent but less than 20 percent of the total mass, for use as LWR fuel.

Low-Level Waste (LLW): Waste that contains radioactivity but is not classified as HLW, TRU waste, spent nuclear fuel, or "11e(2) by-product material" as defined by DOE Order 5820.2A, *Radioactive Waste Management*. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or Pu, may be classified as LLW, provided the concentration is less than 100 nanocuries per gram, which would then be TRU waste. Some LLW is considered classified because of the nature of the generating process and/or constituents, because the waste would tell too much about the process.

Mandatory Standards: Standards adopted by the DOE that define the minimum requirements that the DOE and its contractors must comply with. Standards may be classified as mandatory because of applicable Federal or state statutes or implementing requirements, or as a matter of DOE policy.

Marsh: An area of low-lying wetland, dominated by grasslike plants.

Mastodon: Any of numerous extinct mammals that differ from the related mammoths and existing elephants chiefly in the form of molar teeth.

Maximum Contaminant Level: The maximum permissible level of a contaminant in drinking water delivered to any user of a public water system. Maximum contaminant levels are enforceable standards.

Maximally Exposed Individual (MEI): A hypothetical person who could potentially receive the maximum dose of radiation or hazardous chemicals.

Megajoule: A unit of power equal to 1 million joules. See "Joule."

Megawatt (MW): A unit of power equal to 1 million watts. Megawatt thermal is commonly used to define heat produced, while megawatt electric defines electricity produced.

Mesozoic: The geologic era dating from 245 million to 66 million years ago. The Mesozoic Era is the era of the dinosaurs.

Metal: Essentially pure Pu metal that meets weapons specifications. The Pu can be weapons grade, fuels grade, or reactor grade. The metal may have oxidation or casting residues on the surface.

Metal Reduction: The conversion of a compound such as plutonium dioxide or plutonium tetrafluoride into metal.

Metamorphic Rock: Rock formed by the transformation of preexisting rocks in response to changes in temperature and/or pressure, and the chemical action of fluids.

Meteorology: The science dealing with the atmosphere and its phenomena, especially as relating to weather.

Migration: The natural movement of a material through the air, soil, or groundwater; also, seasonal movement of animals from one area to another.

***Migratory Bird Treaty Act*:** This act states that it is unlawful to pursue, take, attempt to take, capture, possess, or kill any migratory bird, or any part, nest, or egg of any such bird other than permitted activities.

Minor Actinides: Radioactive element with an atomic number larger than 95 (that is, 96 or higher).

Miocene: A geologic epoch in the Cenozoic Era dating from 26 to 7 million years ago.

Mississippian Period (Geologic): A portion of the Paleozoic Era in North America dating from 360 to 330 million years ago (following the Devonian Period and preceding the Pennsylvanian Period).

Mixed Oxide (MOX): A physical blend of uranium oxide and plutonium oxide.

Mixed Waste: Waste that contains both "hazardous waste" and "radioactive waste" as defined in this glossary.

Modified Mercalli Intensity (MMI): A level on the modified Mercalli scale. A measure of the perceived intensity of earthquake ground shaking with 12 divisions, from I (not felt by people) to XII (damage nearly total). It is a unitless expression of observed effects.

Mutation: Inheritable changes in the DNA molecules found in genes as a result of exposure to various environmental factors such as radiation or certain chemicals.

National Ambient Air Quality Standards (NAAQS): Air quality standards established by the CAA, as amended. The primary NAAQS are intended to protect the public health with an adequate margin of safety, and the secondary NAAQS are intended to protect the public welfare from any known or anticipated adverse effects of a pollutant.

National Asset Reserve: The quantity of U.S. Pu above that amount in the stockpile, the production process, R&D inventories, and the strategic reserve.

National Emission Standards for Hazardous Air Pollutants (NESHAP): A set of national emission standards for listed hazardous pollutants emitted from specific classes or categories of new and existing sources. These were implemented in the CAA Amendments of 1977.

***National Environmental Policy Act* (NEPA) of 1969:** This Act is the basic national charter for the protection of the environment. It requires the preparation of an EIS for every major Federal action that may significantly affect the quality of the human or natural environment. Its main purpose is to provide environmental information to decision makers so that their actions are based on an understanding of the potential environmental consequences of a proposed action and its reasonable alternatives.

National Environmental Research Park (NERP): An outdoor laboratory set aside for ecological research to study the environmental impacts of energy developments. NERPs were established by DOE to provide protected land areas for research and education in the environmental sciences and to demonstrate the environmental compatibility of energy technology development and use.

***National Historic Preservation Act* (NRHP) of 1966, as amended:** This Act provides that property resources with significant national historic value be placed on the NRHP. It does not require any permits but, pursuant to Federal code, if a proposed action might impact an historic property resource, it mandates consultation with the proper agencies.

National Pollutant Discharge Elimination System (NPDES): Federal permitting system required for discharge of effluents to surface waters of the United States, regulated through the CWA, as amended.

National Register of Historic Places (NRHP): A list maintained by the Secretary of the Interior of districts, sites, buildings, structures, and objects of prehistoric or historic local, state, or national significance. The list is expanded as authorized by Section 2(b) of the *Historic Sites Act* of 1935 (16 U.S.C. 462) and Section 101(a)(1)(A) of the NHPA of 1966, as amended.

***Native American Graves and Repatriation Act* (NAGPRA) of 1990**: Established to protect Native American graves and associated funerary objects. This act requires Federal agencies and museums to inventory human remains and associated funerary objects and to provide culturally affiliated tribes with the inventory of collections. Requires repatriation, on request, to the culturally affiliated tribes.

Natural Uranium: Uranium with a U-235 concentration of approximately 0.7 percent, the average concentration of U-235 in uranium in the natural, pre-enriched state.

Neutron Poison: A chemical solution (for example, boron or rare earth solution) injected into a nuclear reactor to absorb neutrons and end criticality.

Nitrogen Oxides: Refers to the oxides of nitrogen, primarily NO and NO_2. These are produced in the combustion of fossil fuels and can constitute an air pollution problem. When NO_2 combines with VOCs such as ammonia or CO, ozone is produced.

***Noise Control Act* of 1972:** This Act directs all Federal agencies to carry out programs in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health or welfare.

Nonattainment Area: An air quality control region (or portion thereof) in which EPA has determined that ambient air concentrations exceed national ambient air quality standards for one or more criteria pollutants.

Nonproliferation: Preventing the spread of nuclear weapons, nuclear weapons materials, and nuclear weapon technology.

Nonproliferation Treaty: A treaty with the aim of controlling the spread of nuclear weapons technologies, limiting the number of nuclear weapons states and pursuing, in good faith, effective measures relating to the cessation of the nuclear arms race. The treaty does not invoke stockpile reductions by nuclear states, and it does not address actions of nuclear states in maintaining their stockpiles.

Notification Level: A term used only in NPDES permitting. Discharges are permitted under NPDES for particular parameters; however, when parameters that have not been permitted appear in excess of a predetermined concentration (that is, 100 milligrams per liter), the discharger is required by the NPDES permit to notify the permitter (the EPA) that a new parameter has appeared. Violations of NPDES concentration limits are usually called "noncompliances."

Nuclear Assembly: Collective term for the primary, secondary, and case of a nuclear explosive device.

Nuclear Component: A part of a nuclear weapon that contains fissionable or fusionable material.

Nuclear Criticality: See "Criticality."

Nuclear Facility: A facility whose operations involve radioactive materials in such form and quantity that a nuclear hazard potentially exists to the employees or the general public. Included are facilities that: produce, process, or store radioactive liquid or solid waste, fissionable materials, or tritium; conduct separations operations; conduct irradiated materials inspection, fuel fabrication, decontamination, or recovery operations; or conduct fuel enrichment operations. Incidental use of radioactive materials in a facility operation (for example, check sources, radioactive sources, and x-ray machines) does not necessarily require a facility to be included in this definition.

Nuclear Grade: Material of a quality adequate for use in a nuclear application.

Nuclear Material: Composite term applied to (1) special nuclear material; (2) source material such as uranium or thorium or ores containing uranium or thorium; and (3) by-product material, which is any radioactive material that is made radioactive by exposure to the radiation incident to the process of producing or using special nuclear material.

Nuclear Power Plant: A facility that converts nuclear energy into electrical power. Heat produced in a nuclear reactor is used to make steam which drives a turbine connected to an electric generator.

Nuclear Reactor: A device in which a fission chain reaction is maintained, and which is used for irradiation of materials or to produce heat for the generation of electricity.

Nuclear Weapon: The general name given to any weapon in which the explosion results from the energy released by reactions involving atomic nuclei, either fission, fusion, or both.

Nuclear Weapons Complex: See "Complex."

Nuclide: A species of atom characterized by the constitution of its nucleus and hence by the number of protons, the number of neutrons, and the energy content.

Obsidian: A black volcanic glass.

Occupational Safety and Health Administration (OSHA): Oversees and regulates workplace health and safety, created by *Occupational Safety and Health Act* of 1970.

Off-specification: Material not meeting the requirements for use.

Onsite Population: DOE and contractor employees who are on duty, and onsite visitors.

Operable Unit: A discrete action that comprises an incremental step toward comprehensively addressing site problems. This discrete portion of a remedial response manages migration or eliminates or mitigates a release, threat of release, or pathway of exposure. The cleanup of a site can be divided into a number of operable units.

Option: A group of related alternative pathways through a specific set of facilities that takes surplus fissile material to complete disposition. See alternative options.

Outfall: The discharge point of a drain, sewer, or pipe as it empties into a body of water.

Oxidation: The combination of an atom with another atom (normally oxygen). During this reaction, the atom combines with oxygen and loses electrons.

Oxide: A compound in which an element (such as Pu) is bonded to oxygen.

Ozone: The triatomic form of oxygen; in the stratosphere, ozone protects the Earth from the sun's ultraviolet rays, but in lower levels of the atmosphere ozone is considered an air pollutant.

Package: For radioactive materials, the packaging together with its radioactive contents as presented for transport (the packaging plus the radioactive contents is the package).

Packaging: For radioactive materials, it may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shock to ensure compliance with DOT regulations.

Paleoindian: Term applied to both (1) the period to which the earliest presence of humans can be traced, dating in North America to the late Pleistocene (circa 10,000-12,000 before the present), and (2) the earliest human groups identified in North America (for example, Clovis and Folsom points are considered to have been manufactured by Paleoindian peoples).

Paleontology: The study of extinct plant and animal life that existed in former geologic times, especially fossils.

Paleozoic: The longest era of geologic time, dating from 570 million to 245 million years ago. Seed-bearing plants, amphibians, and reptiles first appeared in the Paleozoic Era.

Palustrine: Lakes, ponds and other enclosed open waters at least 8 ha (20 acres) in extent and dominated by trees, shrubs and emergent vegetation.

Pascal: A metric unit of pressure equal to one Newton per square meter; 101,000 pascals is equal to 14.7 lb/in^2.

Passivation: To make inactive or less reactive by coating or surface treatment.

Perched Groundwater: A body of groundwater of small lateral dimensions lying above a more extensive aquifer.

Perennial Creek: A stream or reach of a stream that flows continuously throughout the year and whose upper surface generally stands lower than the water table in the region adjoining the stream.

Permeability: The ability of rock or soil to transmit a fluid. It is the measure of the relative ease of fluid flow under unequal pressure.

Person-rem: The unit of collective radiation dose commitment to a given population; the sum of the individual doses received by a population segment.

Petroglyph: Art carved or inscribed on a rock by a historic or prehistoric people.

pH: A numeric value that indicates the relative acidity or alkalinity of a substance on a scale of 0 to 14, with the neutral point at 7.0. Acid solutions have pH values lower than 7.0 and basic (alkaline) solutions have pH values higher than 7.0.

Physical Setting: The land and water form, vegetation, and structures that compose the landscape.

Physiography: Description of earth surface features.

Piedmont Province: Area of rolling topography between the Appalachian mountain range and the coastal plain, extending from New Jersey to Alabama. The Piedmont is underlain chiefly by Precambrian and Paleozoic metamorphic and igneous rocks, but it also has relatively large areas underlain by Triassic sedimentary rocks and sporadic basaltic sills and dikes.

Pit: The core element of a nuclear weapon's "primary" or fission component.

Pit Cladding: The material that encapsulates a pit to form a hermetic seal around the pit.

Playa: A dry lake bed in a desert basin or a closed depression that contains water on a seasonal basis.

Pleistocene: The geological time of the earliest epoch of the Quaternary Period, occurring approximately 11,000 to 2 million years ago, characterized by a succession of northern glaciations and the appearance of human beings.

Pliocene: The geological time of the latest epoch of the Tertiary Period, occurring approximately 2 million to 7 million years ago, characterized by the appearance of distinctly modern animals.

Plume: The elongated pattern of contaminated air or water originating at a point source, such as a smokestack or a hazardous waste disposal site.

Plume Immersion: Occurs when an individual is enveloped by a cloud of radioactive gaseous effluent and receives an external radiation dose.

Plutonium: A heavy, radioactive, metallic element with the atomic number 94. It is produced artificially in a reactor by bombardment of uranium with neutrons and is used in the production of nuclear weapons. Plutonium has 15 isotopes with mass numbers ranging from 232 to 246. The weapons-usable plutonium consists mainly of Pu-239, which has a radioactive decay half-life of 24,110 years.

Polychlorinated Biphenyl (PCB): Any of family of chlorinated chemicals that are noted as dangerous environmental pollutants that can accumulate in animal tissues with resultant pathogenic or teraogenic (causing birth defects) effects.

Position: See "Storage Position."

Post Closure Period: An indefinitely long period (hundreds of millions of years) extending from closure of the facility to a time when the emplaced waste is no longer a security or safety hazard. It is expected that, at least during the early years, the facility will be safeguarded and monitored.

Potable (Water): Fit to drink.

[Text deleted.]

Potential Fatalities: A conservative estimate of those fatalities that would result from both radiological and nonradiological risks from normal operations and accident conditions for a proposed action.

Pounds per Square Inch: A measure of pressure; atmospheric pressure is about 14.7 lb/in^2.

Power Reactor-Grade Material: Pu and HEU in various forms (for example, metals and oxides) that can be used in commercial nuclear power reactors. Power reactor-grade Pu contains greater than 19 percent Pu-240.

Precambrian: Dating from before the Cambrian geologic period more than 570 million years ago.

Precipitate: To cause a solid substance to become separate from a solution.

Prehistoric: Predating written history. In North America, also predating contact with Europeans.

Pressurized Water Reactor (PWR): A nuclear power reactor that uses water under pressure as a coolant. The water boiled to generate steam is in a separate system.

Prevention of Significant Deterioration (PSD): Regulations established by the CAA to limit increases in criteria air pollutant concentrations above baseline.

Primary System: The system that circulates a coolant (for example, water) through the reactor core to remove the heat of reaction.

Prime Farmland: Land with the best combination of physical and chemical characteristics (soil quality, growing season, and moisture supply) for economically producing high yields of food, feed, forage, fiber, and oilseed crops, with minimum inputs of fuel, fertilizer, pesticides, and labor without intolerable soil erosion (*Farmland Protection Policy Act* of 1981, 7 CFR 7, paragraph 658). Land classified as prime farmland includes cropland, pastureland, rangeland, or forest land; but not urban or built-up land or land covered with water. Prime farmlands are identified by the NRCS (also known as Soil Conservation Service).

Prime Farmland Soils: Soil map units that meet the soil requirements for prime farmland.

Probabilistic Risk Assessment (PRA): A comprehensive, logical, and structured methodology to identify and quantitatively evaluate significant accident sequences and their consequences.

Probable Maximum Flood: Flood levels predicted for a scenario having hydrological conditions that maximize the flow of surface waters.

Process: To extract, separate, or purify a substance by physical or chemical means (for example, to remove actinides).

Programmatic Environmental Impact Statement (PEIS): A document prepared in accordance with the requirements of 102(2)(C) of NEPA which evaluates the environmental impacts of proposed Federal Actions that involve multiple decisions potentially affecting one or more sites.

Project: Any undertaking with a defined starting point and defined objectives by which completion is identified.

Project-Specific EIS: A legal document prepared in accordance with the requirements of 102(2)(C) of NEPA which evaluates the environmental impacts of a single action at a single site.

Proliferation: The spread of nuclear, biological, and chemical capabilities and the missiles to deliver them.

Protected Area (PA): An area encompassed by physical barriers, subject to access controls, surrounding material access areas, and meeting the standards of DOE Order 5632.1C, *Protection and Control of Safeguards and Security Interests*.

Quality Factor: The principal modifying factor that is employed to derive dose equivalent from absorbed dose.

Quaternary: The second geologic period of the Cenozoic Era, occurring from 2 million years ago to the present, characterized by the appearance of human beings.

Rad: See "Radiation Absorbed Dose."

Radiation: The emitted particles or photons from the nuclei of radioactive atoms. Some elements are naturally radioactive; others are induced to become radioactive by bombardment in a reactor. Naturally occurring radiation is indistinguishable from induced radiation.

Radiation Absorbed Dose: The basic unit of absorbed dose equal to the absorption of 0.01 joule per kilogram of absorbing material.

Radioactive Accident Risk: As described in the *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes* (NUREG-0170), it is the probability of an accident in which the release of radioactive material is likely to occur, and its consequences. The consequences are expressed in terms of the potential effects of the release of a specified quantity of dispersible radioactive material to the environment or the exposure resulting from a damaged package shielding. The risk calculations incorporate accident rates and package release fraction estimates, both of which are functions of accident severity. Radiological accident risks are expressed in terms of annual expected latent cancer fatalities and early fatality probabilities.

Radioactive Vehicle Accident: A vehicle accident involving one or more packages of radioactive material that could result in a loss of shielding efficiency of the package, or a loss of containment and subsequent dispersal of the radioactive material, or an accidental assembly of a critical mass (in fissile material shipments).

Radioactive Waste: Materials from nuclear operations that are radioactive or are contaminated with radioactive materials, and for which use, reuse, or recovery are impractical.

Radioactivity: The spontaneous decay or disintegration of unstable atomic nuclei, accompanied by the emission of radiation.

Radioisotopes: Radioactive nuclides of the same element (same number of protons in their nuclei) that differ in the number of neutrons.

Radiolysis: Chemical decomposition induced by radiation.

Radionuclide: A radioactive element characterized according to its atomic mass and atomic number which can be man-made or naturally occurring. Radionuclides can have a long life as soil or water pollutants, and are believed to have potentially mutagenic or carcinogenic effects on the human body.

Radon: Gaseous, radioactive element with the atomic number 86 resulting from the radioactive decay of radium. Radon occurs naturally in the environment, and can collect in unventilated enclosed areas, such as basements. Large concentrations of radon can cause lung cancer in humans.

Raptor: A bird of prey, such as an eagle, hawk, or falcon.

Reactor Accident: See "Design-Basis Accident" *and* "Severe Accident."

Reactor Core: In a heavy water reactor: the fuel assemblies, including the fuel and target tubes, control assemblies, blanket assemblies, safety rods, and coolant/moderator. In a LWR: the fuel assemblies, including the fuel and target rods, control rods, and coolant/moderator.

Reactor Facility: Unless it is modified by words such as containment, vessel, or core, the term reactor facility includes the housing, equipment, and associated areas devoted to the operation and maintenance of one or more reactor cores. Any apparatus that is designed or used to sustain nuclear chain reactions in a controlled manner, including critical and pulsed assemblies and research, test, and power reactors, is defined as a reactor. All assemblies designed to perform subcritical experiments that could potentially reach criticality are also to be considered reactors.

[Text deleted.]

Recharge: Replenishment of water to an aquifer. Can occur as a result of surface infiltration of rainwater (or other sources) and through leakage between aquifers.

Record of Decision (ROD): A document prepared in accordance with the requirements of 40 CFR 1505.2 that provides a concise public record of DOE's decision on a proposed action for which an EIS was prepared. A ROD identifies the alternatives considered in reaching the decision, the environmentally preferable alternative(s), factors balanced by DOE in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they were not.

Recycling: The recovery, purification, and reuse of tritium contained in reservoirs within the nuclear weapons stockpile.

Reference Standards: Guides or standards that the DOE and its contractors should consider for guidance, as applicable, in addition to mandatory standards.

Region of Influence (ROI): A site-specific geographic area that includes the counties where approximately 90 percent of the current DOE and/or contractor employees reside.

Regional Economic Area (REA): A geographic area consisting of an economic node and the surrounding counties that are economically related and include the places of work and residences of the labor force. Each REA is defined by the BEA.

Rem: See "Roentgen Equivalent Man."

Remediate: Render radioactive, hazardous, or mixed waste environmentally safe, whether through processing, entombment, or other methods.

Remediation: The process, or a phase in the process, of rendering radioactive, hazardous, or mixed waste environmentally safe, whether through processing, entombment, or other methods.

Reprocessing: The chemical separation of spent reactor fuel into uranium, transuranic elements, and fission products.

Residue: Pu materials in process or left over from processes of making weapons.

***Resource Conservation and Recovery Act* (RCRA) as Amended:** The Act that provides a "cradle to grave" regulatory program for hazardous waste that establishes, among other things, a system for managing hazardous waste from its generation until its ultimate disposal.

Retirement: As applied to nuclear weapons, the removal of a weapon from the stockpile.

Rhyolite: A volcanic rock rich in silica; the volcanic equivalent of granite.

Richter Scale: A logarithmic scale used to express the total amount of energy released by an earthquake; it has 10 divisions, from 1 (not felt by humans) to 10 (nearly total damage).

Riffle: A rocky shoal or sand bar lying just below the surface of a waterway.

Riparian: On or around rivers or streams.

Riparian Wetlands: Wetlands on or around rivers and streams.

Rip rap: A loose assemblage of stones used in water or soft ground to prevent erosion.

Risk: A quantitative or qualitative expression of possible loss that considers both the probability that a hazard will cause harm and the consequences of that event.

Risk Assessment (Chemical Or Radiological): The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemical or radiological pollutants.

Roentgen: A unit of exposure to ionizing x- or gamma radiation equal to or producing 1 electrostatic unit of charge per cubic centimeter of air. It is approximately equal to 1 rad.

Roentgen Equivalent Man (rem): The unit of radiation dose for biological absorption: equal to the product of the absorbed dose, in rads, a quality factor which accounts for the variation in biological effectiveness of different types of radiation.

Runoff: The portion of rainfall, melted snow, or irrigation water that flows across the ground surface and eventually enters streams.

Ruthenium: A brittle gray metal. A radioactive form of ruthenium is a common fission product.

***Safe Drinking Water Act* (SDWA), as Amended:** This Act protects the quality of public water supplies, water supply and distribution systems, and all sources of drinking water.

Safe Secure Trailer (SST): A specially designed semi-trailer, pulled by a specially designed tractor, which is used for the safe, secure transportation of cargo containing nuclear weapons or special nuclear material.

Safety: Minimizing the possibility that a nuclear weapon will be exposed to accidents and preventing the possibility of nuclear yield or Pu dispersal should there be an accident involving a nuclear weapon.

Safety Analysis Report (SAR): A safety document providing a concise but complete description and safety evaluation of a site, design, normal and emergency operation, potential accidents, predicted consequences of such accidents, and the means proposed to prevent such accidents or mitigate their consequences. A safety analysis report is designated as final when it is based on final design information. Otherwise, it is designated as preliminary.

Safety Document: A document prepared specifically to ensure that the safety aspects of part or all of the activities conducted at a reactor are formally and thoroughly analyzed, evaluated, and recorded (for example, technical specifications, safety analysis reports and addenda, and documented reports of special safety reviews and studies).

Salt Drift: Deposition of salts from the drifting of mist from cooling tower operation and the associated deposition of entrained chemicals.

Saltcrete: A solidified mixture of salt residue from the evaporation process at a liquid waste treatment facility and Portland cement.

Saltstone: Low radioactivity fraction of high-level waste from the in-tank precipitation process mixed with cement, flash, and slag to form a concrete block.

Sandstone: A sedimentary rock composed mostly of sand-size particles cemented usually by calcite, silica, or iron oxide.

Sanitary Wastes: Wastes generated by normal housekeeping activities, liquid or solid (includes sludge), which are not hazardous or radioactive.

Sanitization: An irreversible modification or destruction of a component or part of a component to the extent required to prevent revealing classified or otherwise controlled information.

Schist: Crystalline metamorphic rock formed by dynamic metamorphism that can be split easily into thin slabs or flakes.

Scintillation: Minute flash of light caused when alpha, beta, or gamma rays strike certain phosphors.

Scope: In a document prepared pursuant to NEPA, the range of actions, alternatives, and impacts to be considered.

Scoping: Involves the solicitation of comments from interested persons, groups, and agencies at public meetings, public workshops, in writing, electronically, or via fax to assist DOE in defining the proposed action, identifying alternatives, and developing preliminary issues to be addressed in an EIS.

Scrap: Pu materials in process or left over from process of making weapons.

Scrubber: An air pollution control device that uses a spray of water or reactant or a dry process to trap pollutants in emissions.

Secondary: Component of a nuclear weapon that contains elements needed to initiate the fusion reaction in thermonuclear explosion.

Secondary System: The system that circulates a coolant (water) through a heat exchanger to remove heat from the primary system.

Security: Minimizing the likelihood of unauthorized access to or loss of custody of a nuclear weapon or weapon system, and ensuring that the weapon can be recovered should unauthorized access or loss of custody occur.

Sedimentary Rock: Rock formed from the accumulation and consolidation of sediments.

Sedimentation: The settling out of soil and mineral solids from suspension in water.

Seepage Basin: An unlined excavation in the ground that receives aqueous effluent.

Seismic: Pertaining to any earth vibration, especially an earthquake.

Seismic Zone: An area defined by the Uniform Building Code (1991), designating the amount of damage to be expected as the result of earthquakes. The United States is divided into six zones: (1) Zone 0—no damage; (2) Zone 1—minor damage; corresponds to intensities V and VI of the MMI scale; (3) Zone 2A—moderate damage; corresponds to intensity VII of the MMI scale (eastern U.S.); (4) Zone 2B—slightly more damage than 2A (western U.S.); (5) Zone 3—major damage; corresponds to intensity VII and higher of the MMI scale; (6) Zone 4—areas within Zone 3 determined by proximity to certain major fault systems.

Seismicity: The tendency for the occurrence of earthquakes.

Sensitivity Level: The relative degree of viewer numbers, visibility of the subject landscape and the degree of potential viewer interest, concern, and attitude for existing or proposed changes in landscape character.

Severe Accident: An accident with a frequency rate of less than 10^{-6} per year that would have more severe consequences than a design-basis accident, in terms of damage to the facility, offsite consequences, or both.

Sewage: The total of organic waste and wastewater generated by an industrial establishment or a community.

Shale: A type of easily split rock composed of layers of claylike, fine-grained sediments.

Shielding: Any material of obstruction (bulkheads, walls, or other constructions) that absorbs radiation in order to protect personnel or equipment.

Short-Lived Nuclides: Radioactive isotopes with half-lives no greater than about 30 years (for example, Cs-137 and Sr-90).

Shrink-Swell Potential: Refers to the potential for soils to contract while drying and expand after wetting.

Shutdown: For a DOE reactor, that condition in which the reactor has ceased operation and DOE has declared officially that it does not intend to operate it further.

Silica: Silicon dioxide, a common mineral that occurs naturally as quartz.

Silt: A sedimentary material consisting of fine mineral particles intermediate in size between sand and clay.

Siltstone: A fine-grained, elastic (fragmented) sedimentary rock in which particles range from 1/6 to 1/256 millimeters in diameter.

Sinkhole: A depression in the earth's surface formed by the collapse of a cavern roof. Typically associated with Karnst terrain.

Sitewide EIS: A legal document prepared in accordance with the requirements of 102(2)(C) of NEPA which evaluates the environmental impacts of many actions at one large, multiple-facility site. Sitewide EISs are used to support specific decisions.

Slope Factor: A upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. The slope factor is used to estimate an upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen.

Socioeconomic Baseline Characterization: A description and discussion of the social and economic characteristics of a study area, including a profile of local population, economy, housing supply, and public and private services.

Solution: Liquid mixtures containing Pu.

Source Term: The estimated quantities of radionuclides or chemical pollutants released to the environment.

Spec Metal (Specification Metal): Pu metal whose impurities do not exceed an established concentration.

Special Nuclear Materials: As defined in Section 11 of the AEA, special nuclear material means (1) Pu, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the NRC determines to be special nuclear material or (2) any material artificially enriched by any of the foregoing.

Spent Fuel Standard: A term coined by the NAS and modified by DOE, means that alternatives for the disposition of surplus weapons-usable Pu should seek to make this Pu roughly as inaccessible and unattractive for weapons use as the much larger and growing stock of Pu in civilian spent nuclear fuel.

Spent Nuclear Fuel: Irradiated reactor fuel that is no longer useful as fuel.

Stabilize: To convert a compound, mixture, or solution to a non-reactive form.

Stage Right: A horizontal palletized multiple stacking configuration of pits in containers at Pantex. The operation utilizes an electric forklift with shielding for radiation protection for storage, retrieval, and inventory operations. The shielded fork lift has a passive guidance system (for example, rail guides, wire guides) for the palletized stacking configuration that prevents the forklift from veering from the aisle.

Staging: An interim storage or gathering of items awaiting use, transportation, consumption, or other disposition.

Standardization (Epidemiology): Techniques used to control the effects of differences (for example, age) between populations when comparing disease experience. The two main methods are the following:

- Direct method, in which specific disease rates in the study population are averaged, using as weights the distribution of the comparison population.

- Indirect method, in which the specific disease rates in the comparison population are averaged, using as weights the distribution of the study population.

Standby: That condition in which a reactor facility is neither operable nor declared excess and in which documentary authorization exists to maintain the reactor for possible future operation.

State Historic Preservation Officer (SHPO): State officer established to carry out the duties associated with the NHPA, for identification and protection of prehistoric and historic resources.

Steppe: A semi-arid, grass-covered, and generally treeless plain.

Steppe Climate (Semiarid Climate): The type of climate in which precipitation is very slight but sufficient for the growth of short, sparse grass.

Storage: Any method of keeping items while awaiting use, transportation, consumption, or other disposition.

Storage Position: A cubicle with dimensions of 46 cm (18 in) wide by 46 m (18 in) deep by 57 cm (24 in) tall. It is sized to accommodate one pit or nonpit primary containment vessel per storage position for Pu or a single drum or can per position for HEU. This configuration is necessary for criticality and heat load considerations of the Pu and HEU material stored within each position.

[Text deleted.]

Stored Weapons Standard: This invokes the high standards of security and accounting applied to the storage of intact nuclear weapons. Therefore, applying the Stored Weapons Standard means those high standards should be maintained to the extent practical for weapons-usable fissile materials throughout dismantlement, storage, and disposition.

Straight-Line: A site-independent pilot Pu management system.

Strategic Reserve Material: The quantity of Pu and HEU material reserved for future weapons use.

Stratigraphy: Division of geology dealing with the definition and description of rocks and soils, especially sedimentary rocks.

Sulfur Oxides: Common air pollutants, primarily SO_2, a heavy, pungent, colorless gas (formed in the combustion of coal), which is considered a major air pollutant, and sulfur trioxide.

***Superfund Amendments and Reauthorization Act* (SARA) of 1986:** In addition to certain freestanding provisions of law, it includes amendments to CERCLA and the SDWA.

Surface Water: Water on the Earth's surface, as distinguished from water in the ground (groundwater).

Surplus Facility: Any facility or site (including installed equipment) that has no identified programmatic use or that may or may not be radioactively contaminated to levels that require controlled access.

Surplus Fissile Materials: Weapons-usable fissile materials that have no identified programmatic use or do not fall into one of the categories of national security reserves.

System International: For the purpose of this PEIS, synonymous with the metric system.

Technology: A specific technical component that is subset of a facility; for example, glass melter and feed preparation technology might fall under vitrification of Pu in borosilicate glass.

Tectonic Plate: One of the massive rigid plates that together form the Earth's lithosphere, or outermost layer (crust).

Tertiary: The first geologic period of the Cenozoic Era, dating from 66 million to about 3 million years ago. During the Tertiary, mammals became the dominant life form.

Threatened Species: Defined in the ESA of 1973 as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

Threshold Limit Values: The recommended concentrations of contaminants workers may be exposed to according to the ACGIH.

***Toxic Substances Control Act* (TSCA) of 1976:** This Act authorizes the EPA to secure information on all new and existing chemical substances and to control any of these substances determined to cause an unreasonable risk to public health or the environment. This law requires that the health and environmental effects of all new chemicals be reviewed by the EPA before they are manufactured for commercial purposes.

Transmissivity: A measure of a water-bearing unit's capacity to transmit fluid: the product of the thickness and the average hydraulic conductivity of a unit. Also, the rate at which water is transmitted through a strip of an aquifer of a unit width under a unit hydraulic gradient at a prevailing temperature and pressure.

Transparency: Exchange of information, access to facilities, and cooperative arrangements undertaken to provide ready observation and verification of defense or other activities.

Transportation and Emergency Management Program: The transportation program is responsible for the safe movement of wastes among facilities for the purposes of treatment, storage, and disposal. The emergency management program is responsible for coordinating the response to adverse occurrences in environmental restoration and waste management operations.

Transuranic: Any element whose atomic number is higher than that of uranium (that is, atomic number 92). All transuranic elements are produced artificially and are radioactive.

Transuranic Waste: Waste contaminated with alpha-emitting radionuclides with half-lives greater than 20 years and concentrations greater than 100 nanocuries/gram at time of assay. It is not a mixed waste.

Treatment: An operation necessary to prepare material for disposal.

Triassic: First period of the Mesozoic Era, dating from between 245 to 208 million years ago.

Tritium: A radioactive isotope of the element hydrogen with two neutrons and one proton. Common symbols for the isotope are H-3 and T.

Tritium Recycling: The recovery, purification, and reuse of tritium contained in tritium reservoirs within the nuclear weapons stockpile.

Tuff: A fine-grained rock composed of volcanic ash.

Tunnel Drift: A small cross cut in a mine connecting two larger tunnels.

Unconfined Aquifer: A permeable geological unit having the following properties: a water-filled pore space (saturated), the capability to transmit significant quantities of water under ordinary differences in pressure, and an upper water boundary that is at atmospheric pressure.

Unsaturated Zone (Vadose): A region in a porous medium in which the pore space is not filled with water.

Uranium: A heavy, silvery-white metallic element (that is, atomic number 92) with many radioactive isotopes. U-235 is most commonly used as a fuel for nuclear fission. Another isotope, U-238, is transformed into fissionable Pu-239 following its capture of a neutron in a nuclear reactor.

Viewshed: The extent of the area that may be viewed from a particular location. Viewsheds are generally bounded by topographic features such as hills or mountains.

Visual Resource Management (VRM): A methodology devised by the BLM to analytically assess the aesthetic quality of a landscape. The objective of this process is to lessen the visual impact of proposed activities while these actions are still in the design stage. The process consists of a rating of site visual quality (see VRM Class) followed by a measurement of the degree of contrast between proposed development activities and the existing landscape.

Visual Resource Management Class: As part of the BLM Visual Resource Management process, an inventory and evaluation of visual resources is conducted and lands are assigned a relative visual rating or management classification. There are five classes which define the different degrees of modification to landscape elements: Class 1 would apply to pristine areas including designated wilderness and wild and scenic rivers; Class 2 would apply to areas with very limited land development activity resulting in contrasts that are seen but do not attract attention; Class 3 would apply to areas where contrasts caused by development activity are evident, but the natural landscape still dominates; Class 4 would apply to areas where contrasts caused by human activities attract attention and are dominant features of the landscape in terms of scale, but repeat the contrast of the characteristic landscape; Class 5 would apply to areas where contrasts caused by cultural activities are the dominant feature of the landscape to the point that the natural landscape character no longer exists.

Visual Resources: Natural and cultural features that define the appearance of a particular landscape.

| [Text deleted.]

Vitrification: A waste treatment process that uses glass (for example, borosilicate glass) to encapsulate or immobilize radioactive wastes.

Volatile Organic Compounds: A broad range of organic compounds, often halogenated, that vaporize at ambient or relatively low temperatures, such as benzene, chloroform, and methyl alcohol.

Waste: A discardable residue from a manufacturing or purification process.

Waste Isolation Pilot Plant (WIPP): A facility in southeastern New Mexico being developed as the disposal site for transuranic and transuranic mixed waste, not yet in operation.

Waste Minimization and Pollution Prevention: An action that economically avoids or reduces the generation of waste and pollution by source reduction, reducing the toxicity of hazardous waste and pollution, improving energy use, or recycling. These actions will be consistent with the general goal of minimizing present and future threats to human health, safety, and the environment.

Waste Package: The waste, waste container, and any absorbent that is intended for disposal as a unit. In the case of surface contaminated, damaged, leaking, or breached waste packages, any overpack shall be considered the waste container, and the original container shall be considered part of the waste.

Wastewater: Spent water originating from all aspects of human sanitary water use (domestic wastewater) and from a myriad of industrial processes that use water for a variety of purposes (industrial wastewater).

Water Quality Standard and Criteria: Concentration limit of constituents or characteristics allowed in water; often based on water use classifications (for example, drinking water, recreation use, propagation of fish and aquatic life, and agricultural and industrial use). Water quality standards are legally enforceable: water quality criteria are non-enforceable recommendations based on biotic impacts.

Water Table: The first water encountered below the surface of the ground occurs in two zones, an upper unsaturated zone and a deeper saturated zone. The boundary between the two zones is the water table.

Weapon Secondary: See "Secondary."

Weapon System: Collective term for the nuclear assembly and weapons usable nonnuclear components, subsystems, and systems that comprise a nuclear weapon.

Weapons Assembly/Disassembly: Assembly operations assembles piece parts into subassemblies using joining techniques such as welding, adhesive bonding, and mechanical joining. Disassembly takes retired weapons apart and recycles all materials of value.

Weapons-Grade Material: Pu or HEU, in metallic form, that has been removed from weapons as a result of stockpile downsizing, and Pu and HEU parts that were manufactured for weapons application. Weapons-grade Pu contains less than 7 percent Pu-240.

Weapons Laboratories: Colloquial term for the three DOE national laboratories—Los Alamos, Lawrence Livermore, and Sandia—that are responsible for the design, development, and stewardship of U.S. nuclear weapons.

Weapons Retirement: The process by which nuclear weapons are determined to be obsolete or unnecessary for national defense. A retired weapons or weapon system is no longer in an active status or deliverable, but may still be a fully functioning nuclear device.

Weapons-Usable Material: Pu and HEU in various forms (for example, metals and oxides) that can be readily converted for use in nuclear weapons, including weapons-grade, fuel-grade, and power reactor-grade Pu.

Weighting Factor: Represents the fraction of the total health risk resulting from uniform whole-body irradiation that could be contributed to that particular tissue.

Wet Site: For the purposes of this PEIS, any site where adequate surface water is available for the various storage and disposition needs.

Wetland: Land or areas exhibiting hydric soil conditions, saturated or inundated soil during some portion of the year, and plant species tolerant of such conditions.

Whole-Body Dose: Dose resulting from the uniform exposure of all organs and tissues in a human body. Also, see "Effective Dose Equivalent."

***Wild and Scenic Rivers Act*:** This Act establishes a National Wild and Scenic Rivers System to preserve and protect the free-flowing condition of selected rivers with outstanding natural, cultural, or recreational features. For Federally-owned land within the boundaries of rivers in the System, certain activities that would have a direct and adverse effect on river values may be controlled.

Wind Rose: A depiction of wind speed and direction frequency for a given period of time.

χ/Q (Chi/Q): The relative calculated air concentration due to a specific air release; units are (sec/m^3). For example, (Ci/m^3)/(Ci/sec)=(sec/m^3) or (gm/m^3)/(gm/sec)=(sec/m^3).

[Text deleted.]

2R Container: An inner containment vessel for radioactive materials built to approved specifications of the DOT pursuant to 49 CFR 178.360-1. Each 2R vessel must be made of stainless steel, malleable iron, or brass, or other material having equivalent physical strength and fire resistance. The inside diameter of the vessel may not exceed 30 cm (12 in) with a wall thickness no less than for schedule 40 pipe. Each 2R vessel must have welded, brazed, screw-type or flanged closure devices which meet DOT specifications.

6M: A container which resembles a 55-gallon stainless steel drum which DOE uses as an outer container with impact absorber material (Type B packaging) placed inside the container to protect the inner container (usually a Type 2R) which is typically used to ship radioactive material.

Chapter 8
List of Preparers

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Years of Experience: 26

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B.S., Electrical Engineering, 1965, Naval Post Graduate School, Monterey, CA
B.S., Naval Science, 1955, U.S. Naval Academy, Annapolis, MD
Years of Experience: 21

Bienenfeld, Paula, Cultural and Paleontological Specialist, Tetra Tech, Inc.
Ph.D., Anthropology, 1986, State University of New York at Binghamton, Binghamton, NY
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Years of Experience: 18

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Years of Experience: 6

Blauer, H. Mark, Deputy Program Manager, Tetra Tech, Inc.
Ph.D., Nuclear Chemistry, 1977, University of Glasgow, Scotland
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B.S., Chemistry, 1968, State University of New York at Stony Brook, Stony Brook, NY
Years of Experience: 28

Boucher, Marc, Fissile Materials Storage Specialist, SRA Technologies, Inc.
B.S., Nuclear Engineering, 1991, University of Florida, Gainesville, FL
Years of Experience: 5

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B.S., Civil Engineering, 1971, Auburn University, Auburn, AL
Years of Experience: 25

Cambria, Michael J., Infrastructure and Immobilization Specialist, SRA Technologies, Inc.
M.S., Nuclear Engineering, 1964, Pennsylvania State University, State College, PA
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Years of Experience: 32

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M.S., Public Administration, 1981, George Washington University, Washington, DC
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Years of Experience: 22

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M.A., English, 1992, Virginia Polytechnic Institute and State University, Blacksburg, VA
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Years of Experience: 6

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Ph.D., Civil Engineering, 1986, Virginia Polytechnic and State University, Blacksburg, VA
M.S., Civil Engineering, 1979, Orta Dogu Technical University, Ankara, Turkey
B.S., Civil Engineering, 1976, Orta Dogu Technical University, Ankara, Turkey
Years of Experience: 15

Davis, Larry J., Nuclear Weapons Design and Engineering Technical Coordinator, Lamb Associates, Inc.
M.S., Physics, 1971, Naval Postgraduate School, Monterey, CA
B.S., Mathematics, 1964, Jacksonville State University, Jacksonville, AL
Years of Experience: 32

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Ph.D., Microbiology/Biochemistry, 1966, University of Texas, Austin, TX
M.A., Bacteriology/Genetics, 1960, University of Texas, Austin, TX
B.A., Zoology/Chemistry, 1958, University of Texas, Austin, TX
Years of Experience: 35

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Ph.D., Public Policy, 1987, Florida State University, Tallahassee, FL
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B.A., Political Science, 1976, Saint Leo College, Saint Leo, FL
Years of Experience: 15

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B.S., Geology, 1985, Stockton State College, Pomona, NJ
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Years of Experience: 10

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B.S., Geology, 1979, Southern Illinois University, Carbondale, IL
Years of Experience: 17

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M.S., Nuclear Engineering, 1978, Oregon State University, Corvallis, OR
M.L.S., Library Science, 1975, University of Pittsburgh, Pittsburgh, PA
M.S., Materials Engineering, 1974, University of Maryland, College Park, MD
B.S., Metallurgical Engineering, 1972, Chen Kung University, Taiwan
Years of Experience: 19

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Ph.D., Transportation Management, 1987, Kensington University, Glendale, CA
M.A., Business Administration/Management, 1986, University of Washington Joint Center for Graduate Studies, Richland, WA
B.A., 1970, College of Advance Traffic, Chicago, IL
Years of Experience: 36

Gerard, Thomas A., Immobilization Technology Specialist, SRA Technologies, Inc.
M.B.A., 1989, Golden Gate University, San Francisco, CA
M.S., Civil Engineering, 1976, California Institute of Technology, Pasadena, CA
B.S., Engineering, 1970, U.S. Military Academy, West Point, NY
Years of Experience: 26

Grant, Johnnie W., Waste Management Task Leader, Lamb Associates, Inc.
M.S., Physics, 1978, Arizona State University, Tempe, AZ
B.S., Military Science, 1969, U.S. Military Academy, West Point, NY
Years of Experience: 26

Hamilton, Michael A., Facility Security Manager, SRA Technologies, Inc.
B.A., Liberal Arts, 1981, University of Central Florida, Orlando, FL
Years of Experience: 14

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M.P., Environmental Planning, 1995, University of Virginia, Falls Church, VA
B.A., Urban Studies, 1983, University of Maryland, College Park, MD
Years of Experience: 11

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B.S., Civil Engineering, 1992, Virginia Polytechnic Institute and State University, Blacksburg, VA
Years of Experience: 4

Humes, Donald C., Waste Management and Socioeconomics Specialist, SRA Technologies, Inc.
M.S., Environmental Engineering, 1994, Colorado State University, Fort Collins, CO
B.S., Electrical Engineering, 1989, Villanova University, Villanova, PA
Years of Experience: 5

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Registered Professional Landscape Architect, 1967
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M.A., Engineering Administration, 1987, George Washington University, Washington, DC
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Years of Experience: 9

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Ph.D., Biological Chemistry, 1970, University of California, Los Angeles, CA
Postdoctoral Study, Electron Microscopy, 1971, University of Colorado Medical Center, Denver, CO
M.S., Business Administration, 1991, Strayer College, Washington, DC
B.S., Chemistry, 1966, New Mexico State University, Las Cruces, NM
Years of Experience: 25

Jones, Rebecca, Comment Analysis and Response Coordinator, Tetra Tech, Inc.
B.A., Broadcast Journalism, 1992, West Texas A & M, Canyon, TX
Years of Experience: 4

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B.S., Chemical Engineering, 1968, University of Connecticut, Storrs, CT
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M.P.P., Public Policy, 1981, Wharton School, University of Pennsylvania, Philadelphia, PA
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Years of Experience: 13

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B.S., Biology, 1979, Shippensburg University, Shippensburg, PA
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Years of Experience: 14

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M.A., Meteorology, 1974, South Dakota School of Mines and Technology, Rapid City, SD
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B.A., History, 1990, Pennsylvania State University, University Park, PA
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M.S., Nuclear Engineering, 1979, University of Tennessee, Knoxville, TN
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M.S., Operations Research, 1970, George Washington University, Washington, DC
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Years of Experience: 34

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Years of Experience: 20

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M.S., Nuclear Engineering, 1972, University of New Mexico, Albuquerque, NM
Years of Experience: 25

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M.B.A., 1972, University of Utah, Salt Lake City, UT
B.S., Air Science, 1960, Oklahoma State University, Stillwater, OK
Years of Experience: 33

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M.S., Mechanical Engineering, 1970, Stanford University, Stanford, CA
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Years of Experience: 15

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Ph.D., Wildlife Management, 1974, Michigan State University, East Lansing, MI
B.S., Zoology, 1967, University of Cincinnati, Cincinnati, OH
Years of Experience: 23

Schlegel, Robert, Health Physics Specialist, Halliburton NUS Corp.
M.S., Nuclear Engineering, 1961, Columbia University, New York, NY
B.S., Chemical Engineering, 1959, Massachusetts Institute of Technology, Cambridge, MA
Years of Experience: 31

Sclichter, Edward F., Commercial MOX Fuel Fabrication Specialist and ADC Reviewer, Lamb Associates, Inc.
Ph.D., Business/Financial Management, 1980, University of Nebraska, Lincoln, NE
M.S., Management, 1967, Naval Postgraduate School, Monterey, CA
B.S., U.S. Naval Academy, 1961, Annapolis, MD
Years of Experience: 31

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B.S., Biochemistry, 1992, University of California Riverside, Riverside, CA
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M.P.H., Health Physics, 1961, University of Michigan, Ann Arbor, MI
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B.S., Civil Engineering, 1956, Case Western Reserve, Cleveland, OH
Years of Experience: 39

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B.S., Industrial Engineering/Management Systems, 1958, General Motors Institute, Flint, MI
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B.S., Physics, 1963, Marshall University, Huntington, WV
Years of Experience: 33

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Years of Experience: 11

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B.S., Electrical Engineering, 1960, Rutgers University, New Brunswick, NJ
Years of Experience: 35

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M.S., Environmental Engineering, 1976, University of Maryland
M.S., Chemical/ Nuclear Engineering, 1970, University of Maryland
M. Tech (M.S.), Chemical Engineering, Plant Design, 1968, Osmania University, India
M. Tech (B.S.), Chemical Engineering, 1966, Osmania University, India
B. Sci. (B.S.), Mathematics, Physics and Chemistry, 1961, Osmania University, India
Years of Experience: 25

Tan, Roy, Health Physics Specialist, Tetra Tech, Inc.
Ph.D., Radiological Environmental Engineering, 1996, University of Cincinnati, Cincinnati, OH
M.S., Nuclear Engineering, 1994, University of Cincinnati, Cincinnati, OH
B.S., Power Engineering, 1982, Harbin Engineering Institute, Harbin, China
Years of Experience: 14

Thayer, Patrick M., Fissile Materials Conversion Technology Specialist, SRA Technologies, Inc.
M.B.A., 1979, University of Colorado, Boulder, CO
B.G.S., Business, 1973, University of Nebraska, Omaha, NE
Years of Experience: 31

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B.A., English, 1991, Vassar College, Poughkeepsie, NY
Years of Experience: 5

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Currently enrolled, University of Virginia, Falls Church, VA
Years of Experience: 26

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B.A., Environmental Science/Geology, 1984, University of Virginia, Charlottesville, VA
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B.S., Atmospheric Science, 1985, National Taiwan University, Taiwan
Years of Experience: 11

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B.A., Physics, 1973, Gordon College, Wenham, MA
Years of Experience: 23

Westbrook, Chris R., Technical Coordinator, Lamb Associates, Inc.
M.S., Nuclear Engineering, 1980, Air Force Institute of Technology, Fairborn, OH
M.B.A., 1976, Webster University, St. Louis, MO
B. S., Nuclear Engineering, 1973, University of Tennessee, Knoxville, TN
Years of Experience: 23

Wilkins, Lawrence, Socioeconomics Specialist, SRA Technologies, Inc.
M.A., Management, 1981, Central Michigan University, Mount Pleasant, MI
B.S., Engineering, 1970, U.S. Military Academy, West Point, NY
Years of Experience: 26

Chapter 9
Federal, State, and Local Agencies and Organizations Contacted

This chapter identifies the various agencies and organizations contacted during the preparation of this Storage and Disposition PEIS. The entities were contacted to actively solicit site-specific data; regulatory compliance requirements; Federal, State, and local laws; or Executive Orders that may be applicable to the proposed alternatives considered.

Aberdeen, Idaho
Aberdeen Fire Department

Adams County, Colorado
Adams County Fire Department

Adams County, Colorado
Adams County Police Department

Adams County, Colorado
Adams County Schools

Adams County, Colorado
Bennett Schools

Adams County, Colorado
Brighton Schools

Adams County, Colorado
Mapleton Schools

Adams County, Colorado
Northglenn-Thornton Schools

Adams County, Colorado
Strasburg Schools

Adams County, Colorado
Westminster Schools

Advisory Council on Historic Preservation
Washington, DC

Aiken, South Carolina
Aiken Fire Department

Aiken County, South Carolina
Aiken County Fire Department

Aiken County, South Carolina
Aiken County School District

Allendale County, South Carolina
Allendale County School District

Allendale Town, South Carolina
Allendale Town Fire Department

Allenspark, Colorado
Allenspark Fire Department

Almer, South Carolina
Almer Fire Department

Amarillo, Texas
Amarillo Fire Department

Amarillo, Texas
Amarillo Planning Department

Amarillo, Texas
Amarillo School District

Ammon, Idaho
Ammon Fire Department

Anderson County, Tennessee
Anderson County Fire Department

Anderson County, Tennessee
Anderson County Police Department

Anderson County, Tennessee
Anderson County School District

Arapahoe County, Colorado
Adams-Arapahoe Schools

Arapahoe County, Colorado
Byers Schools

Arapahoe County, Colorado
Cherry Creek Schools

Arapahoe County, Colorado
Deer Trails Schools

Arapahoe County, Colorado
Englewood Schools

Arapahoe County, Colorado
Littleton Schools

Arapahoe County, Colorado
Sheridan Schools

Armstrong County, Texas
Claude School District

Arvada, Colorado
Arvada Fire Department

Ash Meadows National Wildlife Refuge, Nevada

Augusta, Georgia
Augusta Fire Department

Aurora, Colorado
Aurora Fire Department

Bamberg County, South Carolina
Bamberg District #1

Bamberg County, South Carolina
Bamberg District #2

Bamberg County, South Carolina
County Administrator's Office
Emergency Preparedness-Fire

Bannock County, Idaho
Bannock County Fire Department

Bannock County, Idaho
Marsh Valley School District

Bannock County, Idaho
Pocatello School District

Barnwell County, South Carolina
Barnwell School District #19

Barnwell County, South Carolina
Barnwell School District #29

Barnwell County, South Carolina
Barnwell School District #45

Basin City, Washington
Basin City Fire Department

Bennett, Colorado
Bennett Fire Department

Benton City, Washington
Benton City Fire Department

Benton County, Washington
Finley School District

Benton County, Washington
Horse Haven Fire Department

Benton County, Washington
Kiona-Benton School District

Benton County, Washington
Patterson School District

Bingham County, Idaho
Aberdeen School District

Bingham County, Idaho
Blackfoot School District

Bingham County, Idaho
Firth School District

Bingham County, Idaho
Shelley School District

Bingham County, Idaho
Snake River School District

Blackfoot, Idaho
Blackfoot Fire Department

Bonneville County, Idaho
Bonneville School District

Bonneville County, Idaho
Idaho Falls School District

Bonneville County, Idaho
Swan Valley School District

Boulder County, Colorado
Boulder County Police Department

Boulder County, Colorado
Boulder Valley Schools

Boulder County, Colorado
Office of Emergency Management-Fire

Boulder County, Colorado
St. Vrain Valley Schools

Boulder, Colorado
Boulder Fire Department

Brighton, Colorado
Brighton Fire Department

Buffalo Creek, Colorado
Buffalo Creek Fire Department

Butte County, Idaho
Arco School District

Butte County, Idaho
Butte County Fire Department

Byers, Colorado
Byers Fire Department

Canyon, Texas
Canyon Fire Department

Canyon, Texas
Canyon School District

Carson County, Texas
Claude School District

Clark County, Nevada
Clark County Fire Department

Clark County, Nevada
Clark County School District

Clinton, Tennessee
Clinton City Fire Department

Clinton, Tennessee
Clinton City Police Department

Clinton, Tennessee
Clinton City School District

Columbia Basin
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Columbia National Wildlife Refuge Project Leader

Columbia County, Georgia
Columbia County Fire Department

Columbia County, Georgia
Columbia County School District

Commerce City, Colorado
Commerce City Fire Department

Conifer, Colorado
Conifer Fire Department

Connell, Washington
Connell Fire Department

Cowiche, Washington
Cowiche Fire Department

Deer Trail, Colorado
Deer Trail Fire Department

Denver County, Colorado
Denver County Fire Department

Denver County, Colorado
Denver County Schools

Denver County, Colorado
Department of Local Affairs-Population

Edgewater, Colorado
Edgewater Fire Department

Eldorado Springs, Colorado
Eldorado Springs Fire Department

Englewood, Colorado
Englewood Fire Department

Evergreen, Colorado
Evergreen Fire Department

Fairfax, South Carolina
Fairfax Fire Department

Federal Heights, Colorado
Federal Heights Fire Department

Firth, Idaho
Firth Fire Department

Franklin County, Washington
North Franklin School District

Franklin County, Washington
Star School District

Georgia Center for Disease Control and Prevention

Gleed, Washington
Gleed Fire Department

Glendale, Colorado
Glendale Fire Department

Glendale, Tennessee
Glendale Fire Department

Golden, Colorado
Golden Fire Department

Grandview, Washington
Grandview Fire Department

Grandview, Washington
Grandview School District

Granger, Washington
Granger Fire Department

Granger, Washington
Granger School District

Greenback, Tennessee
Greenback Fire Department

Greenwood Village, Colorado
Greenwood Village Fire Department

Groom, Texas
Groom Fire Department

Groom, Texas
Groom School District

Hamer, Idaho
Hamer Fire Department

Harriman, Tennessee
Harriman Fire Department

Harriman, Tennessee
Harriman Police Department

Harriman, Tennessee
Harriman School District

Henderson, Nevada
Henderson Fire Department

Hephzibah, Georgia
Hephzibah Fire Department

Hygiene, Colorado
Hygiene Fire Department

Idaho Falls, Idaho
Idaho Falls Fire Department

Idaho Falls, Idaho
Idaho Falls Planning Department

Idledale, Colorado
Idledale Fire Department

Indian Hills, Colorado
Indian Hill Fire Department

Jameston, Colorado
Jameston Fire Department

Jefferson County, Colorado
Department of Emergency Preparedness-Fire

Jefferson County, Colorado
Jefferson County Schools

Jefferson County, Idaho
Jefferson County Fire Department

Jefferson County, Idaho
Jefferson School District

Jefferson County, Idaho
Ririe School District

Jefferson County, Idaho
West Jefferson School District

Kahlotus, Washington
Kahlotus Fire Department

Kahlotus, Washington
Kahlotus School District

Kennewick, Washington
Kennewick Fire Department

Kennewick, Washington
Kennewick School District

Kingston, Tennessee
Kingston Fire Department

Kingston, Tennessee
Kingston Police Department

Knox County, Tennessee
Knox County Fire Department

Knox County, Tennessee
Knox County Police Department

Knox County, Tennessee
Knox County School District

Knoxville, Tennessee
Knoxville Fire Department

Knoxville, Tennessee
Knoxville Police Department

Lafayette, Colorado
Lafayette Fire Department

Lake City, Tennessee
Lake City Fire Department

Lake City, Tennessee
Lake City Police Department

Lakewood, Colorado
Lakewood Fire Department

Las Vegas, Nevada
Las Vegas Fire Department

Lenoir City, Tennessee
Lenoir City Fire Department

Lenoir City, Tennessee
Lenoir City Police Department

Lenoir City, Tennessee
Lenoir City School District

Littleton, Colorado
Littleton Fire Department

Longmont, Colorado
Longmont Fire Department

Los Alamos County, New Mexico
Community Development Director

Loudon County, Tennessee
Loudon County Fire Department

Loudon County, Tennessee
Loudon County Police Department

Loudon County, Tennessee
Loudon County School District

Loudon, Tennessee
Loudon Fire Department

Loudon, Tennessee
Loudon Police Department

Louisville, Colorado
Louisville Fire Department

Lyons, Colorado
Lyon Fire Department

Mabton, Washington
Mabton Fire Department

Mabton, Washington
Mabton School District

Martin, South Carolina
Martin Fire Department

Martinez, Georgia
Martinez Fire Department

Menan, Idaho
Menan Fire Department

Mesa, Washington
Mesa Fire Department

Morrison, Colorado
Morrison Fire Department

Naches, Washington
Naches Fire Department

National Institute for Occupational Safety and Health
Division of Surveillance
Hanford Evaluation and Field Studies

Nederland, Colorado
Nederland Fire Department

Nile, Washington
Nile Fire Department

Norris, Tennessee
Norris Fire Department

Norris, Tennessee
Norris Police Department

North Augusta, South Carolina
North Augusta Fire Department

North Las Vegas, Nevada
North Las Vegas Fire Department

Northglenn, Colorado
Northglenn Fire Department

Nye County, Nevada
Nye County Fire Department

Nye County, Nevada
Nye County Planning Department

Nye County, Nevada
Nye County School District

Oak Ridge, Tennessee
Oak Ridge Fire Department

Oak Ridge, Tennessee
Oak Ridge Planning Department

Oak Ridge, Tennessee
Oak Ridge Police Department

Oak Ridge, Tennessee
Oak Ridge School District

Oliver Springs, Tennessee
Oliver Springs Fire Department

Oliver Springs, Tennessee
Oliver Springs Police Department

Osage, Texas
Osage Fire Department

Panhandle Groundwater Conservation District 3

Panhandle, Texas
Panhandle Fire Department

Panhandle, Texas
Panhandle School District

Parker, Colorado
Parker Fire Department

Pasco, Washington
Pasco Fire Department

Pasco, Washington
Pasco School District

Philadelphia, Tennessee
Philadelphia Fire Department

Plymouth, Washington
Plymouth Fire Department

Pocatello, Idaho
Pocatello Fire Department

Potter County, Texas
Bushland School District

Potter County, Texas
Highland Park School District

Potter County, Texas
Potter County Fire Department

Potter County, Texas
River Road School District

Prosser, Washington
Prosser Fire Department

Prosser, Washington
Prosser School District

Richland, Washington
Richland Fire Department

Richland, Washington
Richland School District

Richmond County, Georgia
Richmond County Fire Department

Richmond County, Georgia
Richmond County School District

Rigby, Idaho
Rigby Fire Department

Roane County, Tennessee
Roane County Fire Department

Roane County, Tennessee
Roane County Police Department

Roane County, Tennessee
Roane County School District

Roane County, Tennessee
Roane County Zoning Officer

Roberts, Idaho
Roberts Fire Department

Rockwood, Tennessee
Rockwood Fire Department

Rockwood, Tennessee
Rockwood Police Department

Rollinsville, Colorado
Rollinsville Fire Department

Santa Fe County, New Mexico
Planning Department

Sedalia, Colorado
Sedalia Fire Department

Selah, Washington
Selah Fire Department

Selah, Washington
Selah School District

Shelley, Idaho
Shelley Fire Department

Sheridan, Colorado
Sheridan Fire Department

Skellytown, Texas
Skellytown Fire Department

Skyline, Colorado
Skyline Fire Department

State of Colorado
Education Department

State of Colorado
Public Health and Environment Department
Water Quality Division
Drinking Water Section

State of Idaho
Education Department

State of Idaho
Health and Welfare Department

State of Nevada
Conservation and Natural Resources Department
Environmental Protection Division
Water Quality Section

State of Nevada
Conservation and Natural Resources Department
State Engineer

State of Nevada
Conservation and Natural Resources Department
Water Planning Division

State of New Mexico
Education Department

State of New Mexico
Energy, Minerals, and Natural Resources Department
Forest Resources and Conservation Division
Fire Management Bureau

State of New Mexico
Environment Department
Drinking Water Program Division

State of New Mexico
Environment Department
Ground Water Quality Bureau

State of New Mexico
Public Safety Department

State of New Mexico
State Engineer's Office

State of South Carolina
Education Department

State of South Carolina
Health and Environmental Control Department
Environmental Quality Control Division
Drinking Water Bureau

State of South Carolina
Health and Environmental Control Department
Environmental Control Division
Water Pollution Control Bureau

State of South Carolina
Natural Resources Department
Water Resources Division
Water Use Section

State of South Carolina
Transportation Department

State of Tennessee
Department of Health

State of Tennessee
Education Department

State of Tennessee
Environmental Conservation Department
Environment Bureau
Division of Water Pollution Control

State of Tennessee
Health and Environment Department
Office of Water Management

State of Tennessee
Transportation Department

State of Texas
Department of Health
Division of Water Hygiene

State of Texas
Health Department
Bureau of Chronic Disease Prevention and Control
Cancer Registry Division

State of Texas
Natural Resources Conservation Commission

State of Texas
Water Commission

Strasburg, Colorado
Strasburg Fire Department

Sunnyside, Washington
Sunnyside Fire Department

Sunnyside, Washington
Sunnyside School District

Swan Valley, Idaho
Swan Valley Fire Department

Teleco, Tennessee
Teleco Fire Department

Thorton, Colorado
Thorton Fire Department

Tieton, Washington
Tieton Fire Department

Toppenish, Washington
Toppenish Fire Department

Toppenish, Washington
Toppenish School District

U.S. Department of Agriculture
Natural Resources Conservation Service
Benton County, Washington

U.S. Department of Agriculture
Natural Resources Conservation Service
Franklin County, Washington

U.S. Department of Agriculture
Soil Conservation Service
Aiken County, South Carolina

U.S. Department of Agriculture
Soil Conservation Service
Albuquerque, New Mexico

U.S. Department of Agriculture
Soil Conservation Service
Silver City, New Mexico

U.S. Department of Commerce
Bureau of Economic Analysis

U.S. Department of the Interior
Bureau of Land Management
Big Butte Resource Area

U.S. Department of the Interior
Bureau of Land Management
Idaho Falls District

U.S. Department of the Interior
National Park Service
Seattle, Washington

U.S. Department of the Interior
National Park Service
Washington, DC

U.S. Department of the Interior
National Register of Historic Places
Washington, DC

U.S. Department of the Interior
National Rivers Program Manager

U.S. Department of the Interior
U.S. Fish and Wildlife Service
Desert National Wildlife Refuge Complex

U.S. Department of the Interior
U.S. Geological Survey
Arco, Idaho

U.S. Department of the Interior
U.S. Geological Survey
Water Resources Division
Boise, Idaho

U.S. Department of the Interior
U.S. Geological Survey
Oak Ridge, Tennessee

U.S. Environmental Protection Agency
Region IV
Atlanta, Georgia

U.S. Environmental Protection Agency
Region VI
Dallas, Texas

U.S. Environmental Protection Agency
Region VIII
Denver, Colorado

U.S. Environmental Protection Agency
Region IX
San Francisco, California

U.S. Environmental Protection Agency
Region X
Seattle, Washington

Ucon, Idaho
Ucon Fire Department

Umbarger, Texas
Umbarger Fire Department

Union Gap, Washington
Union Gap Fire Department

Union Gap, Washington
Union Gap School District

Wapato, Washington
Wapato Fire Department

Wapato, Washington
Wapato School District

Ward, Colorado
Ward Fire Department

Water Resource Center
Desert Research Institute
University and Community College System of Nevada
Las Vegas/Reno

West Richland, Washington
West Richland Fire Department

Westminster, Colorado
Westminster Fire Department

Wheat Ridge, Colorado
Wheat Ridge Fire Department

White Deer, Texas
White Deer Fire Department

White Deer, Texas
White Deer School District

Yakima County, Washington
Broadway Fire Department

Yakima County, Washington
East Valley School District

Yakima County, Washington
Glade Fire Department

Yakima County, Washington
Highland School District

Yakima County, Washington
Mount Adams School District

Yakima County, Washington
Naches Heights Fire Department

Yakima County, Washington
Naches Valley School District

Yakima County, Washington
Terrace Heights Fire Department

Yakima County, Washington
West Valley Fire Department

Yakima County, Washington
West Valley School District

Yakima, Washington
Yakima Fire Department

Yakima, Washington
Yakima School District

Zillah, Washington
Zillah Fire Department

Zillah, Washington
Zillah School District

Chapter 10
Distribution List

The Department is providing copies of this Final PEIS to Federal, State, and local elected and appointed government officials and agencies; Native American groups; and other organizations and individuals listed below. DOE will distribute bulk quantities of this Final PEIS to some individuals and organizations for further distribution to the organizations listed below (for example, State points of contact). Copies will be provided to other interested parties upon request.

Federal-Elected Officials Representing Affected Areas

States: Colorado
Georgia
Idaho
Nevada
New Mexico
Oregon
South Carolina
Tennessee
Texas
Washington

Congressional Committees

Committee on Appropriations, U.S. Senate
Committee on Appropriations, U.S. House of Representatives
Committee on Armed Services, U.S. Senate
[Text deleted.]
Committee on National Security, U.S. House of Representatives
[Text deleted.]

Governors Representing Affected Areas

States: Colorado
Georgia
Idaho
Nevada
New Mexico
Oregon
South Carolina
Tennessee
Texas
Washington

State-Elected Officials Representing Affected Areas

States: Colorado
Georgia
Idaho
Nevada
New Mexico
Oregon
South Carolina
Tennessee
Texas
Washington

Federal-Recognized Indian Tribes

Alabama-Coushatta Tribe of Texas, TX
All Indian Pueblo Council, NM
Battle Mountain Band Council, NV
Burns-Paiute General Council, OR
Carson Colony Community Council, NV
Chehalis Business Council, WA
Cochiti Pueblo, NM
Coeur D'Alene Tribal Council, ID
Colville Business Council, WA
Colville Tribe, WA
Confederated Tribes of the Umatilla Reservation, OR
Coquille Indian Tribe, OR
Council of Energy Resource Tribes, CO
Dresslerville Community Council, NV
Duckwater Shoshone Indian Tribe, NV
Elko Band Council, NV
Ely Shoshone Indian Tribe, NV
Fort Hall Business Council; Sho Ban Tribes, ID
Hoh Tribal Business Council, WA
Isleta Pueblo, NM
Jemez Pueblo, NM
Jicarilla Apache Tribe, NM
Kickapoo Traditional Tribe of Texas, TX
Las Vegas Indian Center, NV
Las Vegas Indian Colony, NV
Lummi Business Council, WA
Makah Tribal Council, WA
Mescalero Apache Tribe, NM
Moapa Paiute Indian Tribe, NV
Muckleshoot Tribal Council, WA
Nambe Pueblo, NM
Native Indian Association, TN
Nez Perce Tribal Executive Committee, ID
Nisqually Indian Community Council, WA
Pahrump Paiute Indian Tribe, NV
Pojoaque Pueblo, NM

Port Gamble S'Klallam Tribe, WA
Puyallup Tribal Council, WA
Pyramid Lake Paiute Tribal Council, NV
Quileute Tribal Council, WA
Ramah Navajo Chapter, NM
San Felipe Pueblo, NM
San Ildefonso Pueblo, NM
San Juan Pueblo, NM
Santa Ana Pueblo, NM
Santa Clara Pueblo, NM
Santa Domingo Pueblo, NM
Sauk-Suiattle Tribal Council, WA
Shoalwater Bay Tribal Council, WA
Shoshone Paiute Business Council, NV
Skokomish Tribal Council, WA
South Fork Band Council, NV
Southern Ute Tribe, CO
Squaxin Island Tribal Council, WA
Stewart Community Council, NV
Stillaquamish Board of Directors, WA
Summit Lake Paiute Council, NV
Suquamish Tribal Council, WA
Swinomish Indian Tribal Community, WA
Tennessee Commission of Indian Affairs, TN
Tesuque Pueblo, NM
Tribal Council of the Te-Moak Western, NV
Tulalip Board of Directors, WA
Umatilla Board of Trustees, OR
Upper Skagit Tribal Council, WA
Ute Mountain Ute Tribe, CO
Walker River Paiute Tribal Council, NV
Wells Indian Colony Band Council, NV
Western Shoshone Elders Council, NV
Western Shoshone Government, NV
Western Shoshone National Council, NV
Winnemucca Indian Colony, NV
Yakama Indian Nation, WA
Yakama Tribal Council, WA
Yerington Paiute Tribal Council, NV
Yomba Shoshone Indian Tribe, NV
Zia Pueblo, NM
Zuni Pueblo, NM

NEPA Points of Contact by State

States: Colorado
Georgia
Idaho
Nevada
New Mexico
Oregon
South Carolina
Tennessee
Texas
Washington

Federal Agencies

Defense Nuclear Facilities Safety Board
Federal Energy Regulatory Commission
General Accounting Office
[Text deleted]
National Academy of Sciences
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
National Parks and Conservation
National Science Foundation
Office of Technology Assessment
[Text deleted]
U.S. Arms Control and Disarmament Agency
[Text deleted]
U.S. Bureau of Indian Affairs
U.S. Environmental Protection Agency
U.S. Environmental Protection Agency, Region IV
U.S. Environmental Protection Agency, Region VI
U.S. Environmental Protection Agency, Region VII
U.S. Environmental Protection Agency, Region IX
U.S. Environmental Protection Agency, Region X
U.S. National Park Service

State Agencies

BSHWM, Nuclear Emergency Planning, SC
Colorado Department of Health
East Tennessee Economic Council
Georgia Emergency Management Agency
South Carolina Nuclear Waste Program
Southern States Energy Board, GA
State of Idaho, INEL Oversight Program
State of Tennessee DRA
State of Tennessee, DOE Oversight Division
State of Texas, Division of Emergency Management,
State of Texas, Office of the Attorney General
TDEC/DOE Oversight Division, TN
Tennessee Department of Energy and Conservation
Tennessee Department of Health
Tennessee Emergency Management Agency
Texas Natural Resources Conservation Commission
Texas Department of Health
Washington State Department of Ecology
Washington State Energy Office
Western Governors' Association, CO

DOE Reading Rooms

Aiken, SC
Amarillo, TX
[Text deleted]

Idaho Falls, ID
Kirtland AFB, NM
Las Vegas, NV
[Text deleted]
Los Alamos, NM
Oak Ridge, TN
Panhandle, TX
Richland, WA
Westminister, CO

Table 10–1. Representatives From Affected Areas by State (Colorado, Georgia, Idaho, Nevada, New Mexico, South Carolina)

Colorado	Georgia	Idaho	Nevada	New Mexico	South Carolina
City	**City**	**City**	**City**	**City**	**City**
Arvada	Atlanta	Aberdeen	Alamo	Albuquerque	Aiken
Boulder	Augusta	American Falls	Amargosa Valley	Espanola	Almer
Brighton	Bath	Ammon	Ash Springs	Santa Fe	Augusta
Broomfield	Blyth	Arco	Beatty		Batesburg
Denver	Evans	Atomic	Blue Diamond		Blackville
Golden	Girard	Basalt	Boulder City		Beech Island
Lakewood	Harlem	Bellevue	Henderson		Columbia
Longmont	Hephzibah	Blackfoot	Hiko		Denmark
Louisville	Keysville	Carey	Indian Springs		Edgefield
Northglenn	Martinez	Dubois	Las Vegas		Estill
Superior	Millen	Firth	North Las Vegas		Fairfax
Thornton	Sardis	Fort Hall	Pahrump		Gaston
Westminster	Savannah	Hailey	Tonopah		Gloverville
Wheat Ridge	Statesboro	Hamer	Warm Springs		Graniteville
	Thomson	Idaho Falls			Hampton
County	Waynesboro	Iona	**County**		Hilton Head Island
Adams	Wrens	Ketchum	Clark		Jackson
Arapahoe		Lewisville	Nye		Johnston
Boulder	**County**	Menan			Leesville
Denver	Columbia	Mud Lake			Martin
Jefferson	Richmond	Pocatello			Monmorenci
		Richfield			New Ellenton
		Rigby			North
		Ririe			Norway
		Roberts			Orangeburg
		Rupert			Owdoms
		Shelley			Pelion
		Sun Valley			Perry
		Swan Valley			Salley
		Ucon			Saluda
					Springfield
		County			Sycamore
		Bannock			Trenton
		Bingham			Vanville
		Bonneville			Wagener
		Butte			Warrenville
		Jefferson			Williston
					Windsor
					County
					Aiken
					Allendale
					Bamberg
					Barnwell

Table 10–2. Representatives From Affected Areas by State (Tennessee, Texas, Washington)

Tennessee	Tennessee	Texas	Washington
City	**City (Continued)**	**City**	**City**
Alcoa	Maryville	Amarillo	Basin City
Allardt	Mascot	Ashtola	Benton City
Andersonville	Maynardville	Borger	Connell
Athens	Midtown	Bushland	Cowiche
Bethel	New Market	Canyon	Gleed
Blaine	New Tazwell	Channing	Grandview
Briceville	Niota	Clarendon	Granger
Caryville	Norris	Claude	Kahlotus
Clarkrange	Oakdale	Cliffside	Kennewick
Clinton	Oak Ridge	Conway	Mabton
Coalfield	Old Washington	Dawn	Mesa
Corrytown	Oliver Springs	Dial	Naches
Crossville	Oneida	Dumas	Nile
Dandridge	Petros	Electric City	Pasco
Decatur	Philadelphia	Fritch	Plymouth
Deer Lodge	Pigeon Forge	Goodnight	Prosser
Elgin	Pomona	Groom	Richland
Erwin	Powell	Happy	Selah
Etowah	Rockford	Hereford	Sunnyside
Fairfield Glade	Rockwood	Lake Tanglewood	Tieton
Fairview	Rutledge	Osage	Toppenish
Farragut	Sevierville	Paloduro	Union Gap
Friendsville	Sharps Chapel	Pampa	Wapato
Gatlinburg	Solway	Panhandle	West Richland
Glendale	Speedwell	Phillips	Yakima
Grandview	Spring City	Pullman	Zillah
Greenback	Strawberry Plains	Sanford	
Halls Crossroads	Sunbright	Silverton	**County**
Harriman	Sweetwater	Skelleytown	Benton
Huntsville	Talbot	Spearman	Franklin
Jacksonboro	Teleco Village	Stinnett	Yakima
Jamestown	Tellico Plains	Tulia	
Jefferson City	Ten Mile	Umbarger	
Jellico	Townsend	Vega	
Karns	Vonore	Washburn	
Kingston	Walland	Whitedeer	
Knoxville	Wartburg	Wildorado	
Kodak	Washington		
La Follette	Wildwood		

Table 10–2. Representatives From Affected Areas by State (Tennessee, Texas, Washington)—Continued

Tennessee	**Tennessee**	**Texas**	**Washington**
Lake City	**County**	**County**	
Lancing	Anderson	Carson	
Lenoir City	Knox	Potter	
Louisville	Loudon	Randall	
Luttrell	Roane		
Madisonville			

Table 10–3. Individuals Who Provided Comments on the Draft Programmatic Environmental Impact Statement or Have Requested Copies

Alabama
Jim Chardos
Nicholas C. Kazanas
Ricky C. Miles

Arizona
Patricia T. Birnie

California
Masayo Baillet
Joseph E. Blackburn
Barbara Blake
Charles Boardman
Patrick Bonner
Vernon J. Brechin
Wes Brinsfield
John Burroughs
Jacqueline Cabasso
Christine Cockey
Melvin S. Coops
Susako DeAmgelis
Joanne Dean-Freemire
Madeline T. Duckles
H. A. Dutton
Edward Ehrlich
Don Eichelberger
Stephanie D. Ericson
Claire Feder
Michael Franks
Stephanie Fraser
Michael Freemire
Jo Ann Frisch
Elsworth Gerrells
Ernest Goitein
Frank Harris
John Harvey
Dan Hirsch
John Holdren
Helen Hubbard
Diane Hughes
Mary L. Kelley
Praveen Khilnani
Donald F. King
Shigeyuki Kiyooka
Sidney Langer
Andy Lichterman
Peter H. Liederman
Eric William Martens
Dale D. Nesbitt
A. J. (Tony) Neylan
Lillian Nurmela
Virginia M. Oversby
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Steven R. Souza
William G. Sutcliffe
Janis K. Turner
Michael Veiluva
Lynn Wallis
Walter E. Wallis
Marianne Wancura
Ward A. Young

Colorado
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Luanne M. Auble
Maggie Barch
Heaton Butterfield
James A. Ciarlo
Ronald L. Claussen
Samuel H. Cole
Keith Consani
Robert J. Coppin
Jeanne Crouch
Eugene DeMayo
Paula J. Elofson-Gardine
Cal Fager
Darcee Freier
John Graham
Kim R. Grice
Sharon Hardin
James L. Harrington
Scott F. Hatfield
Tim Heaton
Arthur M. Hingerty
Hillary J. Holland
Victor Holm
Miller Hudson
Susan Hurst
Karen M. Johnson
Dawn Kaback
Robert A. Kinsey
Ken Korkia
Reuben O. Maes
Gregory K. Marsh
Tom W. Marshall
Toni McCammon
Al Meiklejohn
LeRoy Moore
David M. Navarro
Karen Norris
Karen North
Douglas A. Parker
Lyman Parkhurst
Vivienne E. Perkins
Thomas M. Rauch
Joe Rippetoe
Phil Rogas
Kay Ryan
Jason Salzman
Jeanie D. Sedgely
Frank W. Smith
Katie L. Smith
Dennis Smits
Jill Smits
Mary Springer-Froese
James S. Stone
James S. Stone, P. E.
Mervyn Tano
Stephen Tarlton
Gary H. Thompson
Alan Trenary
Kenneth Werth
Fred Wilson

Connecticut
Katharine D. Knowles

District of Columbia
Steve Aftergood
David Albright
Sakae Aoyagi
Amelia F. Barton
Anthony R. Barton
Jennifer Blomstrom
Andrew P. Caputo
Audrey Cardwell
Kathy Cash
Andy Chakrabarti
Joseph Circincione
Tom Clements
Thomas Cochran
Kathryn A. Crandall
David Culp
Jonathan Dean
Blythe C. Delgado
William Dircks
Steven Dolley
Ralph Earle
Maureen E. Eldredge
Dan L. Fenstermacher
Marvin S. Fertel

Table 10–3. Individuals Who Provided Comments on the Draft Programmatic Environmental Impact Statement or Have Requested Copies—Continued

District of Columbia (Continued)
Roger Gale
Martin Hamberger
Mark Holt
Daniel Horner
John Isaacs
Andrea Jennetta
Spuregon M. Keeny
Richard T. Kennedy
Michael Krepon
Alan Kuperman
Paul Leventhal
Dunbar Lockwood
Lafaye Louis-Oliver
Tracy Ann McCaffery
David J. McLellan
Rachel McMillan
Marilyn F. Meigs
Jack Mendelsohn
Patricia Metz
Gail Miller
Brian Morrisey
Brian S. Nunn
Mary Olson
Christopher Paine
Sophie M. Ras
Bill Roberts
Charles Schmitz
Rita W. Scott
Warren Stern
Sharon Tanzer
Nadine Thigpen
Morris A. Ward
Gregory Webb
Jennifer Weeks
Karina Wood
Tom Zamora-Collina
Christopher Zimmer

Florida
Kari Akers
Ralph Cantral
Ellen Winchester

Georgia
Debra Abdallah
Mustafah Abdallah
Grady Abrams
Valentis F. Ali
Ed Arnold
Bill Beazley
Sam W. Booher
Lance Brown
Diana Coney
Ken Davis
Dana L. Edwards
Edward E. Floyd
James Lee Frazier, Jr.
Beth Fulmer
Richard Garniewicz
Joseph M. Gilkison
Kathleen Gore
Jim Hardeman
Krista Harris
Warren Hills, Sr.
Altsert Hodge
Chuck Irwin
J. A. Favortie
Richard Johnson
Albert Jones
Thelonious Jones
W. H. Keisimeyer
Joan King
Asiya DeBorah Konte
Clayton M. Lanier
William Lawless
Tony Liutkus
William P. Mayson, Jr.
Mildred McClain
Anne McClure
Trisha McCracken
Mustafa Mohammed
Stephen C. Newman
Christopher Noah
J. Christopher Noah, Sr.
R. A. Pedde
Harold Reheis
Carolin E. Rivard
Lawrence Russell
Karin Schill
Mark Schmitz
Michael F. Sujka
Charles N. Utley
Linda Van Sickle
W. M. Stacey
William Ware
Carolyn White
Robert H. Wilcox

Idaho
David Abbott
Ed Bamberry
Lori Bergfeld
Beatrice Brailsford
Casey Burns
Elisha Calvin
Marlene Christianson
Wayne Clarton
John Commander
G. Ross Darnell
Max Eiden
Carol Fenmore
George A. Freund
Catherine A. Glavin
Ellie Hamilton
Steven Hanson
Marsha Hardy
Roger N. Henry
J. Stephen Herring
Jana K. Hinckley
Elaine Hoggan
Martin Huebner
Christopher Jarrell
Lowell A. Jobe
Michael F. Jolley
David Kahn
Steve Kahn
Mike Keesler
Richard Kenney
Jennifer Kidwell
R. G. Larsen
Gail Lewis-Kido
Brandon Loomis
William G. Lussie
Larry Lyon
Robert McEnaney
Kay C. Merriam
Cathy Middleton
Joy H. Myers
William J. Quapp
Andrew Richardson
David L. Rose
Peggy Scherbinske
Don Smith
Michael Smith
John Tanner
Anita Thomas
A. N. Tschaeche
Bob Tyler

Table 10–3. Individuals Who Provided Comments on the Draft Programmtic Environmental Impact Statement or Have Requested Copies—Continued

Idaho (Continued)
Gordon Venable
Marshal A. Wade
Sonne G. Ward
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Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

Volume III

December 1996

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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, socioeconomics, 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.