3.4 Stockpile Management

Stockpile management activities include dismantlement, maintenance, surveillance, and repair or replacement of weapons and weapons components in the existing stockpile. In the past, a large Complex provided the capability and capacity to rapidly fix any problems found in the stockpile. One of the primary goals of stockpile management is to rightsize functions to provide an effective and efficient manufacturing capability for the smaller stockpile. The individual stockpile management functions can be grouped into five major categories: weapons A/D, nonnuclear components fabrication, pit fabrication, secondary and case fabrication, and HE fabrication. Both intrusive and nonintrusive modification pit reuse are considered inherent capabilities of pit fabrication and nonintrusive modification pit reuse is always considered to be collocated with A/D. Specific alternatives that would enable DOE to maintain its stockpile management responsibilities are shown in table 3.4-1and are discussed below.

Table 3.4-1.--*Stockpile Management Alternatives*

Capability[1]	Y-12	SRS	KCP	Pantex	LANL	LLNL	SNL	NTS
Weapons Assembly/Disassembly[2]								
No Action				X				
Downsize existing capability				X				
Relocate capability								X
Nonnuclear Fabrication								
No Action			X		X		X	
Downsize existing capability			X					
Relocate capability					X[3]	X[3]	X[3]	
Pit Fabrication and Intrusive Modification Pit Reuse [4]								
No Action [5]					X	X		
Reestablish capability		X			X			
Secondary and Case Fabrication[4]								
No Action	X[6]							
Downsize existing capability	X[6]							
Relocate capability					X	X		
High Explosives Fabrication								

No Action				X				
Downsize existing capability				X				
Relocate capability					X	X		

3.4.1 Weapons Assembly/Disassembly Alternatives

Weapons A/D provides the capability to dismantle retired weapons, assemble nuclear and nonnuclear components into nuclear weapons, perform weapons surveillance, store strategic reserves of nuclear components (pits and secondaries), and recertify and requalify pits. In addition, nonintrusive modification pit reuse capabilities would be collocated with the weapons A/D Facility.

To maintain confidence in the safety and reliability of the stockpile, DOE conducts surveillance operations on a statistically significant number of weapons annually. Surveillance operations consist primarily of disassembly and inspection of stockpile weapons returned to DOE from DOD. Most of these weapons are rebuilt and returned to the stockpile during what is called the "protected period." Extra components are built at the end of the production run to replace components attrited by surveillance testing for a specified protected period established by DOD. When the replacement components are exhausted, the weapon is not rebuilt and the stockpile is reduced.

The nonintrusive modification pit reuse alternative would provide a capability to perform nonintrusive modification of pits for reuse in the stockpile. Nonintrusive modification is modification to the external surfaces and features of a pit. For example, to add safety features such as fire resistant cladding, there is little risk of contamination, and the generation of radioactive waste is very low.

Operation. The weapons A/D process consists of five main functions and nonintrusive modification pit reuse, which are described below.

Weapons Assembly. Weapons assembly is performed to produce a new weapon, rebuild a weapon that has been disassembled for surveillance, repair a weapon, or modify or replace components. The assembly steps for a rebuild are the same as for a new weapon, except that the starting point varies depending on the extent of disassembly.

Complete weapons assembly is accomplished in three stages: nuclear explosive package assembly, mechanical assembly, and final package assembly. Nuclear explosive package assembly entails bonding or mating HE main charge subassemblies to a pit and then enclosing this subassembly in a case along with other components such as the secondary. Mechanical weapons assembly entails placing the nuclear explosive package in a warhead or bomb case, then installing the arming, fusing and firing system; neutron generator; and gas transfer system components. Numerous quality control inspections and tests of electrical and mechanical systems are performed throughout the process. Final package assembly involves installing some additional components and packaging the weapons for shipment.

Weapons Disassembly. Weapons disassembly is similar to the reverse of the assembly process and is performed to dismantle, modify, repair, or evaluate a weapon. The operations conducted for each type of disassembly are similar, but the extent of the disassembly and the procedures used vary. Many of the facilities used for various disassembly and testing operations are the same as facilities used for weapons assembly.

Joint Test Assembly and Post-Mortem . As part of the ongoing stockpile surveillance program, weapons are randomly selected from the stockpile or from new production for conversion into a joint test assembly. The nuclear explosive package is removed and replaced with a mock assembly that includes telemetry components. After flight tests by DOD, joint test assemblies are often recovered and returned to the A/D Facility for post-mortem disassembly and evaluation.

Test Bed Assembly and Disassembly. A test bed is an apparatus used for bench testing weapons systems, subsystems, and components. Testing is generally conducted at Pantex in the Weapons Evaluation Test Laboratory operated by SNL. Test beds are disassembled at the A/D Facility after testing.

Optional Storage of Plutonium and Highly Enriched Uranium Strategic Reserve. Storage of the plutonium strategic reserve could occur at the weapons A/D Facility. If Y-12 is selected as the site for the secondary and case fabrication mission, HEU strategic reserve storage would remain at ORR. If Y-12 is not selected, then the HEU strategic reserve could also be stored at the weapons A/D Facility. The strategic reserve provides pits and secondaries which could be used for replacement in the enduring stockpile or as feedstock for nuclear fabrication. The quantities associated with strategic reserve storage are classified. If the decision is made that strategic reserves will be stored with nonstrategic reserves, then consolidated storage could occur at one of the five sites being considered in the Storage and Disposition of Weapons Usable Fissile Materials Programmatic Environmental Impact Statement, rather than at the weapons A/D Facility.

Nonintrusive Modification Pit Reuse . This alternative supports three major operations: pit recertification, pit requalification, and nonintrusive modification. Nonintrusive modification pit reuse includes the operations, inspections, and evaluations that are required to change design features by the addition of shells or other nonnuclear components for the incorporation of fire safety or security improvements. Pits received from strategic reserve storage or weapon disassembly for surveillance or maintenance may be used as feed stock for nonintrusive modification.

The alternatives for A/D are to continue in current facilities at Pantex with only those changes that are currently scheduled and budgeted (No Action), to downsize and consolidate facilities and operations at Pantex, or to relocate operations to NTS.

3.4.1.1 *No Action*

The No Action alternative for these activities, except nonintrusive modification pit reuse, is presently located at Pantex. Pantex dismantles retired weapons, assembles nuclear and nonnuclear components into nuclear weapons, repairs and modifies weapons, evaluates weapons, and performs nonnuclear testing of nuclear weapons. Current plutonium R&D facilities at LANL and LLNL have limited capability and capacity to perform nonintrusive modification pit reuse.

3.4.1.2 *Downsize at Pantex Plant*

This alternative would downsize and consolidate facilities and operations including strategic reserve storage at Pantex primarily into Zone 12 (figure 3.4.1.2-1), using existing modern structures. This alternative is described in more detail in appendix section A.3.1.1.

Downsizing of the A/D operation at Pantex would consist of an in-place decrease in facility footprints

and relocation into modern, existing facilities, mostly within Zone 12. The facilities primarily used are cells and bays that were specifically designed and constructed for A/D operations. The consolidation of the site would not require modification of these structures, but would require relocation and installation of equipment within them. Support functions would remain within the currently established facilities, some of which are outside Zone 12. No new construction would be required at Pantex; however, relocation and reinstallation of equipment would be required.

The capabilities for nonintrusive modification pit reuse would be established in existing facilities within Zone 12. This would require modification of some of the bays to install glove boxes; redesign of the heating, ventilation, and air conditioning; and improvement of the fire detection and suppression systems. These facilities would also have the capability to support pit recertification and requalification operations.

Construction. There would be no new construction anticipated at Pantex for this alternative. The A/D mission would be consolidated primarily into Zone 12 with some supporting operations in Zones 13, 15, and 16. Figure 3.4.1.2-2 shows the weapons A/D site plan for Zone 12 and the facilities included in the proposed downsized and consolidated A/D mission at Pantex. Strategic reserve storage would be in Zone 12 for both plutonium and HEU. The nonintrusive modification pit reuse alternative would require modification of four bays in Building 12-104. The capability to perform recertification, requalification, and nonintrusive modification pit reuse activities currently exists at Pantex except for processes that are needed for pit tube replacement, welding on the pit, and inspection of internal pit surfaces. The existing capabilities would be upgraded and relocated within Building 12-116.

Building 12-116 is a new building that was constructed in accordance with the requirements for a safety class (Category 2) vault-type nuclear facility. This facility would support consolidation of the activities that involve processing of components that contain special nuclear material. Recertification, requalification, and reuse activities would use almost the entire facility.

Building 12-104 is a new building that was also constructed in accordance with the requirements for a safety class (Category 2) nuclear explosives A/D Facility. To fulfill the pit reuse mission, one module (four bays) of the building would be modified to meet nonreactor nuclear facility requirements. These requirements include improvements to the fire detection and suppression system; a capture system for fire water runoff; the addition of control, change out, and decontamination areas; security improvements to provide facility control; and complete redesign of the heating, ventilation, and air conditioning system to provide the progressive negative pressure scenario required for containment of radionuclide contamination. Three of the four bays would be fitted with pit reuse process equipment to provide the minimum capability required to support recertification, requalification, and nonintrusive modification activities. The fourth bay would be available for installation of additional equipment if workload requirements increase. The pit reuse facility would have the capability to support all recertification, requalification, and nonintrusive modification pit reuse activities. Table 3.4.1.2-1 shows building modification construction requirements for downsizing and consolidating into existing facilities.

Table 3.4.1.2-1.-- ***Pantex Plant Weapons Assembly/Disassembly Facility Construction Requirements***

Requirement	Consumption
Material/Resource	
Electrical energy (MWh)	609
Peak electrical demand (MWe)	4
Concrete (m^3)	840
Steel (t)	15
Gasoline, diesel, and lube oil (L)	28,800
Industrial gases [7] (m^3)	600
Water (L)	1,400,000
Land (ha)	NA [8]
Employment	
Total employment (worker years)	99
Peak employment (workers)	67
Construction period (years)	3

Table 3.4.1.2-2.-- ***Pantex Plant Weapons Assembly/Disassembly Facility Surge Operation Annual Requirements***

Requirement	Consumption
Resource	
Electrical energy (MWh)	43,000
Peak electrical demand (MWe)	10
Liquid fuel (L)	740,000
Natural gas [9] (m^3)	7,150,000
Water (L)	196,000,000
Plant Footprint (ha)	NA [10]
Employment (Workers)	1,890 [11]

Operation. Operation requirements for surge operation of the downsized/consolidated weapons A/D facilities are shown in table 3.4.1.2-2.

Process Support Systems. Process support systems include systems, equipment, and procedures that support the weapons A/D processes. The process support systems are described in more detail in appendix section A.3.1.1.

Waste Management. Pantex's existing waste management infrastructure can be applied to manage and treat all anticipated waste streams from this alternative. All hazardous, radioactive, and mixed wastes generated at Pantex facilities would be managed in accordance with all applicable Federal and state waste regulations. The wastes anticipated from the estimated workloads would not require

significant modification of the existing Pantex waste management infrastructure. Waste generation for construction and operation of the Pantex A/D alternative is shown in table 3.4.1.2-3.

Table 3.4.1.2-3.-- Pantex Plant Weapons Assembly/Disassembly Facility Waste Volumes

Category	Annual Average Volume Generated from Construction (m^3)	Annual Volume Generated from Surge Operations (m^3)	Annual Volume Effluent from Surge Operations (m^3)
Low-Level			
Liquid	None	0.06	None
Solid	None	21 [12]	10 [13]
Mixed Low-Level			
Liquid	None	0.06	0.06
Solid	None	Minimal	Minimal
Hazardous			
Liquid	None	2	2
Solid	0.25	0.05	0.05
Nonhazardous (Sanitary)			
Liquid	315	141,000	141,000
Solid	5 [14]	340	170 [15]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	Included in sanitary	Included in sanitary

3.4.1.3 *Relocate to Nevada Test Site*

This alternative is based on the use of the current Device Assembly Facility and balance of plant infrastructure available and required to maintain the capability for underground nuclear testing. The alternative is discussed in more detail in appendix section A.3.1.2. Additional new construction would be required and would be designed and sized to meet the specific needs of the reduced program and enhanced safety and environmental objectives.

Construction. This alternative would require modification of existing facilities and new construction. Nonintrusive modification pit reuse would require construction of a new pit reuse facility as an adjunct to the existing Device Assembly Facility. Equipment for the facility would be purchased or transferred from existing Complex facilities. The new facility would be classified as a nonreactor nuclear facility. Though new construction would be required, the existing NTS infrastructure would be sufficient to support the facility.

The facility would be placed in the backfill area north of the Device Assembly Facility, with a

specific location to be developed in conjunction with the A/D effort. The current Device Assembly Facility would be used for a secure shipping and receiving station with no additional construction requirements.

A site map of the proposed A/D plant is shown in figure 3.4.1.3-1. This map shows the overall plant, including associated support facilities, the plant protected area, and limited area. A site plan of the material access area is shown in figure 3.4.1.3-2. The size, number, and arrangement of the plant building and support areas are conceptual and can change as design progresses. The site plans are included to convey general layout information only.

The existing Device Assembly Facility would form the cornerstone of the A/D plant, but additional facilities to handle the workload, pit reuse, and strategic storage (if appropriate) would have to be added. All plant facilities located within the material access area either occupy existing buildings inside the Device Assembly Facility or are located in hardened new construction connected to the Device Assembly Facility. All plant facilities located within the limited area, at the plant site (adjacent to the Device Assembly Facility), would require new construction. Approximately 11 percent of this construction is needed to support the option of storing strategic reserves of nuclear components (pits and secondaries). Table 3.4.1.3-1 shows construction requirements for the NTS weapons A/D alternative.

Table 3.4.1.3-1.-- ***Nevada Test Site Weapons Assembly/Disassembly Facility Construction Requirements***

Requirement	Consumption
Material/Resource	
Electrical energy (MWh)	38,000
Peak electrical demand (MWe)	5
Concrete (m^3)	75,000
Steel (t)	16,300
Gasoline, diesel, and lube oil (L)	3,030,000
Industrial gases [16] (m^3)	65,100
Water (L)	98,400,000
Land (ha)	3.2 [17]
Employment	
Total employment (worker years)	2,768
Peak employment (workers)	662
Construction period (years)	6

Table 3.4.1.3-2.- ***Nevada Test Site Weapons Assembly/Disassembly Facility Surge Operation Annual Requirements***

Requirement	Consumption
Resource	
Electrical energy (MWh)	45,000
Peak electrical demand (MWe)	7
Gasoline and diesel fuel (L)	432,000
Natural gas[18] (m^3)	3,680,000
Water (L)	98,400,000
Plant Footprint	4.3[19]
Employment (Workers)	1,093[20]

Operation. Operating requirements for surge operation of the NTS weapons A/D Facility are shown in table 3.4.1.3-2. The water usage at NTS is somewhat lower than at Pantex since Pantex has a larger plant population and uses more water for supporting operations such as steam heat.

Waste Management. NTS's existing waste management infrastructure can be applied to manage and treat all anticipated waste streams from this alternative. All hazardous, radioactive, and mixed wastes generated at NTS facilities would be managed in accordance with all applicable Federal and state waste regulations. The wastes anticipated from the estimated workloads would not require significant modification of the existing NTS waste management infrastructure. Waste generation for construction and operation of the NTS A/D alternative is shown in table 3.4.1.3-3.

Table 3.4.1.3-3.-Nevada Test Site Weapons Assembly/Disassembly Facility Waste Volumes

Category	Annual Average Volume Generated from Construction (m^3)	Annual Volume Generated from Surge Operations (m^3)	Annual Volume Effluent From Surge Operations (m^3)
Low-Level			
Liquid	None	0.06	None
Solid	None	30 [21]	15 [22]
Mixed Low-Level			
Liquid	None	None	None
Solid	None	2	2
Hazardous			
Liquid	None	6	6
Solid	5	0.05	0.05
Nonhazardous (Sanitary)			

Liquid	6,670	53,000	53,000
Solid	260 [23]	100	50 [24]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	Included in sanitary	Included in sanitary

3.4.2 Nonnuclear Fabrication Alternatives

Nonnuclear fabrication consists of the following general functions:

- Fabrication of electrical, electronic, electromechanical and mechanical componenets (plastics, metals, and composites), and assembly of arming, fuzing, and firing systems.
- Surveillance inspection and testing of nonnuclear components

The nonnuclear components alternatives provide for the nonnuclear fabrication missions currently residing at KCP. Production requirements for nonuclear components, in terms of factory and field retrofits to weapons, are shown in table 3.1.1.2-1

The alternatives considered for nonnuclear fabrication included downsizing and consolidating existing facilities at KCP, or closing KCP and sharing nonnuclear fabrication functions among SNL, LANL, and/or LLNL. These alternatives are discussed below.

3.4.2.1 *No Action*

The No Action alternative facilities for these activities are presently located at KCP, SNL, and LANL. KCP manufactures nonuclear weapons components and conducts surveillance testing on, and makes repairs to, nonuclear weapons components. SNL conducts system engineering of nuclear weapons, designs and develops nonuclear components, conducts field and laboratory nonnuclear testing, manufactures some nonnuclear weapons components, and provides safety and reliability assessments of the stockpile. LANL also manufactures a few nonnuclear weapons components and conducts surveillance on certain nonnuclear weapons components.

Downsize at Kansas City Plant

The downsized nonuclear fabrication alternative consists of three major factories designed around electronic, mechanical, and engineered materilas product lines; procuring some components from outside sources; and reducing the KCP footprint fo DP activities to 167,000 square meters (m^2) (1.8 million square feet [ft^2]) from the current 297,000 m^2 (3.2 million ft^2). This alternative is discussed in more detail in appendix section A.3.6.1.

Construction. This alternative consists of downsizing and consolidating existing facilities and would require facility modification but no new construction. Currently, KCP occupies approximately 297,000 m^2 (3.2 million ft^2) contained in three buildings: the Main Manufacturing Building, the Manufacturing Support Building, and the Technology Transfer Center (figure 3.4.2.2-1). The downsized and consolidated KCP would reduce the size of the plant to approximately 167,000 m^2

(1.8 million ft^2) for DP activities. The Technology Transfer Center and Manufacturing Support Building facilities would be totally vacated of DP activities. All operations and support functions required for the nonnuclear fabrication mission would be accomplished within the reduced floor space of the Main Manufacturing Building. Vacated floor space would be returned to the General Services Administration or retained for Work for Others use, if appropriate. The downsized KCP facility would consist of the following major factories and product-oriented departments: Electronics Factory, Mechanical Factory, Engineered Materials Factory, Joint Test Assembly and Special Electronic Assembly Department, Reservoir Fabrication and Assembly Department, and Transportation Safeguards Department.

Facilities modification to establish the downsized and consolidated KCP configuration would take approximately 4 years. During this time, major interior building modification would occur. Table 3.4.2.2-1 shows construction requirements for the KCP nonnuclear fabrication alternative.

Table 3.4.2.2-1.-- ***Kansas City Plant Nonnuclear Fabrication Facility Construction Requirements***

Requirement	Consumption
Material/Resource	
Electrical energy (MWh)	Minimal
Peak electrical demand (MWe)	Minimal
Concrete (m^3)	286
Steel (t)	220
Gasoline, diesel, and lube oil (L)	Minimal
Industrial gases [25] (m^3)	Minimal
Water (L)	Minimal
Land (ha)	NA [26]
Employment	
Total employment (worker years)	459
Peak employment (workers)	187
Construction period (years)	4

Operation. The operation of the downsized and consolidated KCP is based on current KCP facilities and missions, downsized and reorganized for efficiency into several modules and product departments.

Electronics Factory. Existing separate departments for electronics products would be combined into the electronics factory and would be designed around three common process modules: microelectronics, interconnects, and final assembly.

Mechanical Factory. KCP has already implemented a process-based approach for most mechanical technologies. The alternative would achieve substantial downsizing in processing areas to maximize efficiency and cost savings. The mechanical factory would be organized around three process modules: mechanical assembly, mechanical welding, and sheet metal and special processing.

Engineered Materials Factory. This factory would manufacture products that depend on special materials (foams, polymers, and composites) for unique performance or functional characteristics. These products include cushions, desiccants, getters, and composite cases. The engineered materials factory would consist of four generic processing modules (machining, pressing, molding, and compounding), one assembly module, and the Polymer Production Facility. The processing and assembly areas would be consolidated, but the Polymer Production Facility would remain unchanged. The facility is a stand-alone facility that produces materials not available from commercial industry. The consolidation of facilities for the engineered materials factory would reduce floor space requirements for these operations by approximately 50 percent.

Joint Test Assembly and Special Electronics Assembly. Even though these products are electronic assemblies similar to the products fabricated in the electronics factory, they would be built in separate areas because of their unique production and security requirements. These production operations would be combined into one organizational unit. This would provide savings in indirect support, yet allow the unique operations practices and security considerations to be maintained.

Reservoir Fabrication and Assembly. Reservoir production, a relatively new responsibility at KCP, was transferred from the Rocky Flats Plant through the previously authorized nonnuclear consolidation program. The new reservoir production area is correctly sized to support the ongoing workload associated with limited-life component exchanges and would not be changed for this alternative.

Transportation Safeguards. Trailer production and escort vehicle modification would continue to be managed and operated as a separate unit. Floor space requirements would be reduced by relocation of the escort vehicle modification operations so they would be contiguous with the trailer operations.

Table 3.4.2.2-2 shows the KCP Nonnuclear Fabrication Facility annual surge operating requirements.

Table 3.4.2.2-2.-- ***Kansas City Plant Nonnuclear Fabrication Facility Surge Operation Annual Requirements***

Requirement	Consumption
Resource	
Electrical energy (MWh)	225,000
Peak electrical demand (MWe)	30
Liquid fuel (L)	None
Natural gas [27] (m^3)	18,900,000
Water (L)	1,340,000,000
Plant Footprint (ha)	NA [28]
Employment (Workers)	2,928 [29]

Waste Management. The KCP waste management infrastructure can be applied to manage and treat all anticipated waste streams from this alternative. All wastes generated at KCP facilities would be managed in accordance with all applicable Federal and state waste regulations. The wastes anticipated from the estimated workload would not require significant modification of the existing

KCP waste management infrastructure. Waste generation for construction and operation of the KCP nonnuclear fabrication alternative is shown in table 3.4.2.2-3.

Table 3.4.2.2-3.-*Kansas City Plant Nonnuclear Fabrication Facility Waste Volumes*

Category	Annual Average Volume Generated from Construction (m^3)	Annual Volume Generated from Surge Operations (m^3)	Annual Volume Effluent From Surge Operations (m^3)
Low-Level[30]			
Liquid	None	None	None
Solid	None	None	None
Mixed Low-Level[30]			
Liquid	None	None	None
Solid	None	None	None
Hazardous			
Liquid	None	60	60
Solid	786	61	61
Nonhazardous (Sanitary)			
Liquid	None	570,000	570,000
Solid	745	310	310
Nonhazardous (Other)			
Liquid	None	223,900	223,900
Solid	None	11,500	11,500

3.4.2.3 *Relocate to Los Alamos National Laboratory*

Historically, LANL has maintained a prototyping capability in support of R&D for nearly all of the components in nuclear weapons that are designed at LANL. The basis for this alternative would be to use the existing infrastructure at LANL to provide for production requirements of the Complex. Figures 3.4.2.3-1 through *(graphic not available)* 3.4.2.3-5 show the technical areas (TAs) involved and the detailed facility layout for key project TAs. Nonnuclear fabrication missions considered for transfer to LANL fall into the following categories: plastics, detonator inert components, and pilot plant; and reservoirs and valves. The LANL nonnuclear fabrication alternative is discussed in more detail in appendix section A.3.6.2.

[Figure 3.4.2.3-2] [Figure 3.4.2.3-3] [Figure 3.4.2.3-4]

Construction

Plastics, Detonator Inert Components, and Pilot Plant. In the areas of plastics production and high energy detonator inert components, existing facilities contain nearly all required processing equipment and facilities to provide for the production mission. LANL facilities currently used for plastics processing and polymer synthesis activities include the Weapons Plastics and Adhesives Facility at TA-16, the Detonator Production Facility at TA-22, Reservoir and Valve Production at TA-3, and a Polymer Synthesis, Processing, and Characterization Facility at TA-35. Additional floor space is available at TA-16 for production and two bays are available in the DX-16 Pilot Processing Facility for large-scale pilot processes. The following facilities, with the specified installations/upgrades, would be used for nonnuclear production activities at LANL: plastics production would be located in TA-16, Buildings 302, 303, 304, 305, 306, and 307; detonator inert components would be manufactured in TA-22, Building 91; and large-scale pilot plant polymer synthesis would occur in TA-16, Building 340. Electrical system upgrades and the installation of new and/or transferred equipment would be required in most of these facilities. Small-scale pilot plant polymer synthesis operations and mold storage, which require no installations or upgrades, would be located in TA-35, Building 213, and TA-16, Building 332, respectively.

Reservoirs and Valves. The basis for the reservoir alternative is to construct a Boost System Production Facility and establish a nuclear-grade material mission. The alternative would dedicate 2,300 m^2 (25,000 ft^2) in TA-3, Building SM-39 (Main Shops) for boost system production and the nuclear grade materials mission. Building modification activities would include removal of existing machine tools and replacement with new or transferred machine tools. No other upgrades would be necessary. The proposed installations and modifications would occur over a 2-year period.

Table 3.4.2.3-1 shows construction requirements to install 50 pieces of equipment and to upgrade electrical systems for the LANL nonnuclear fabrication alternative.

Operation

Plastics, Detonator Inert Components, and Pilot Plant. LANL currently has process equipment and capabilities in place to support much of this mission. Additional processing capability would be transferred from KCP in the areas of polyurethane foam dispensing, intensive mixing, extruding and leaching of cellular silicone, flame spraying, and parylene coating. The proposed plastics production activities would use equipment such as mixers, extruders, roll mills, presses, coaters, screeners, testing equipment, and quality assurance equipment. For pilot plant operations, additional processing capability would be required for large-scale processing of up to 379 liters (L) (100 gallons [gal]). The proposed pilot plant production activities would use reactor vessels, mixer heaters, pulverizers, and solvent recovery equipment during operation. All detonator flat cable processing capability is currently available; however, upgraded equipment would be used to better meet production requirements. Detonator inert component manufacture and assembly operations would use several types of equipment including drills, cleaners, etchers, strippers, developers, scanners, laminators, presses, lasers, and welders.

Table 3.4.2.3-1.-- Los Alamos National Laboratory Nonnuclear Fabrication Facility Construction Requirements

Requirement	Consumption
Material/Resource	
Electrical energy (kWh)	105
Peak electrical demand (kWe)	3.8
Concrete (m^3)	None
Steel (t)	None
Gasoline, diesel, and lube oil (L)	None
Industrial gases [31] (m^3)	None
Water (L)	9,500
Land (ha)	NA [32]
Employment	
Total employment (worker years)	12
Peak employment (workers)	6
Construction period (years)	2

Reservoirs and Valves. Process equipment and capabilities exist at LANL to support small-scale reservoir and valve production. Operation activities would consist of metal machining, inspection, packaging, and storage functions. Typical production equipment would include lathes, mills, drills, grinders, welders, and inspections/testing equipment. Table 3.4.2.3-2 shows the LANL Nonnuclear Fabrication Facility surge operating requirements.

Waste Management. The LANL existing waste management infrastructure can be applied to manage and treat all anticipated waste streams from this alternative. All hazardous and nonhazardous wastes generated at LANL facilities would be managed in accordance with all applicable Federal and state waste regulations. The wastes anticipated from the estimated workload would not require significant modification of the existing LANL waste management infrastructure. Waste generation for construction and operation of the LANL nonuclear fabrication alternative is shown in table 3.4.2.3-3.

Table 3.4.2.3-2- ***Los Alamos National Laboratory Nonnuclear Fabrication Facility Surge Operation Annual Requirements***

Requirement	Consumption
Resource	
Electrical energy (MWh)	525
Peak electrical demand (MWe)	0.23
Liquid fuel (L)	None
Natural gas[33] (m^3)	340
Water (L)	48,300,00
Plant Footprint	NA [34]
Employment (Workers)	315 [35]

Table 3.4.2.3-3.-- ***Los Alamos National Laboratory Nonnuclear Fabrication Facility Waste Volumes***

Category	Annual Average Volume Generated from Construction (m^3)	Annual Volume Generated from Surge Operations [36] (m^3)	Annual Volume Effluent from Surge Operations (m^3)
Hazardous			
Liquid	None	11	11
Solid	None	0.11	0.11
Nonhazardous (Sanitary)			
Liquid	None	568	566 [37]
Solid	None	10	6 [38]
Nonhazardous (Other)			
Liquid	5 [39]	25 [40]	None
Solid	0.04	3 [41]	None

3.4.2.4 *Relocate to Lawrence Livermore National Laboratory*

This alternative calls for LLNL to provide support for nuclear system plastic components. The LLNL Nonnuclear Fabrication Facility would provide the plastic components and polymers currently produced at KCP. These products include filled and unfilled molded parts; syntactic, rigid, and flexible foam parts; composite structures and specialty polymers currently produced at the KCP pilot plant. All processes would be identical to those currently used at KCP, except for the scaling down of the cellular silicone process and one polymer synthesis process.

This alternative would build on LLNL's established plastics fabrication mission. Over half of the equipment to be used is currently operational at LLNL. The laboratory has used this equipment to provide components for prototypes, underground test devices, and hydrotest devices to the weapons program, and numerous other components to other DOE programs. As a result of this established mission, LLNL has developed a site infrastructure that would support this alternative at the Livermore Site (figure 3.4.2.4-1). All facilities meet the current Federal and state environment, safety, and health requirements. The LLNL nonnuclear fabrication alternative is discussed in more detail in appendix section A.3.6.3.

Construction. The LLNL Nonnuclear Fabrication Facility would consist of 15 departments with facilities located primarily in Building B231 and 4 other buildings nearby. No new facility construction is required. Modification efforts would essentially consist of a small to moderate expansion within existing facilities. The fabrication, including polymer synthesis, would be confined to a consolidated area consisting of five adjacent buildings as shown in figure 3.4.2.4-2. Table 3.4.2.4-1 shows construction requirements for the LLNL Nonnuclear Fabrication Facility.

Table 3.4.2.4-1.-- ***Lawrence Livermore National Laboratory Nonnuclear Fabrication Facility Construction Requirements***

Requirement	Consumption
Material/Resource	
Electrical energy (MWh)	21
Peak electrical demand (MWe)	0.05
Concrete (m^3)	7.6
Steel (t)	7.3
Gasoline, diesel, and lube oil (L)	19,900
Industrial gases [42] (m^3)	7.5
Water (L)	79,500
Land (ha)	NA [43]
Employment	
Total employment (worker years)	19
Peak employment (workers)	6
Construction period (years)	5

Operation. The operation of the LLNL nonnuclear fabrication mission includes production or procurement of plastic components, polymers, and composite parts. The processes and products included in the LLNL nonnuclear fabrication alternative are transfer molded parts, compression molded parts, injection molded parts, machined plastic parts, silicone cushions (all types), syntactic components, filled polymers, and polymer synthesis. Table 3.4.2.4-2 shows the surge operating requirement for the LLNL Nonnuclear Fabrication Facility.

Table 3.4.2.4-2.-- ***Lawrence Livermore National Laboratory Nonnuclear Fabrication Facility Surge Operation Annual Requirements***

Requirement	Consumption
Resource	
Electrical energy (MWh)	108
Peak electrical demand (MWe)	0.095
Gasoline and diesel fuel (L)	None
Natural gas [44] (m^3)	28,900
Water (L)	3,790,000
Plant Footprint (ha)	NA [45]
Employment (Workers)	114 [46]

Waste Management. LLNL's existing waste management infrastructure can be applied to manage and treat all anticipated waste streams from this alternative. All hazardous and nonhazardous wastes generated at LLNL facilities would be managed in accordance with all applicable Federal and state waste regulations. The wastes anticipated from the estimated workloads would not require significant

modification of the existing LLNL waste management infrastructure. Waste generation for construction and operation of the LLNL nonnuclear fabrication alternative is shown in table 3.4.2.4-3.

Table 3.4.2.4-3.-- ***Lawrence Livermore National Laboratory Nonnuclear Fabrication Facility Waste Volumes***

Category	Annual Average Volume Generated from Construction (m^3)	Annual Volume Generated from Surge Operations [47] (m^3)	Annual Volume Effluent from Surge Operations (m^3)
Hazardous			
Liquid	0.08	7 [48]	3 [49]
Solid	0.15	None	0.2
Nonhazardous (Sanitary)			
Liquid	36	5,770 [50]	5,770 [51]
Solid	0.9	127 [52]	64 [53]
Nonhazardous (Other)			
Liquid	76	Included in sanitary	Included in sanitary
Solid	10	Included in sanitary	Included in sanitary

3.4.2.5 *Relocate to Sandia National Laboratories*

This alternative would transfer the majority of current KCP missions to the Albuquerque, NM facility of SNL, except for nuclear system plastic components that would go to either LANL or LLNL, and high energy detonator inert components that would go to LANL. In addition, there is the option of moving the reservoir mission to either SNL or LANL.

Only major assemblies or those components requiring special security considerations would be planned for in-house fabrication. SNL production would consist primarily of assembly of procured piece parts. The technologies that have been traditionally retained in-house at KCP, but under this alternative would be produced commercially, include the following: printed wiring boards, interconnect/junction boxes, lasers and electro-optics, interconnect cables, and molded plastic parts. Additionally, SNL would outsource metal machining, hybrid microcircuit substrates, and sheet metal forming. A more detailed discussion of this alternative is provided in appendix section A.3.6.4.

Construction. This alternative would require construction of a new stand-alone production site at SNL, directly east of Technical Area I (figure 3.4.2.5-1). The alternative includes six new buildings and renovation or minor modifications to some existing buildings. The site would have four new production facilities, an office structure, and a central utilities building, all surrounded by a security fence with guards. The facility plot plan is shown in figure 3.4.2.5-2.

The new site would be independent of the existing Technical Area I, but would be connected to the area's utility network. The new construction would total approximately 58,060 m^2(625,000 ft^2), which would be located on 9 ha (22 acres) of available land. In addition to renovation projects, some

existing buildings would undergo minor modifications to accept the new workload. These minor modifications would yield an additional 5,110 m^2(55,000 ft^2) of work space.

The new or modified facilities are Office Facility; Distribution Center Facility, Electronic Assembly Facility, Mechanical Assembly Facility, Special Products Facility, Central Utility Building, and modifications to existing buildings (820, 860, 894, 905, 913, and others). Table 3.4.2.5-1 shows construction requirements for the SNL Nonnuclear Fabrication Facility.

Operation. The nonnuclear fabrication alternative at SNL would operate processes and manufacturing functions similar to those of KCP. Manufacturing activities would be designed to fabricate the numerous electrical and mechanical components of nuclear weapons not proposed to be secured commercially. Fabrication activities would involve a precision machine shop with forges, presses, ovens, other metal-forming and metal-treating equipment, mechanical assembly areas, and clean rooms. Table 3.4.2.5-2 shows the surge operating requirements for the SNL Nonnuclear Fabrication Facility.

Table 3.4.2.5-1.-- ***Sandia National Laboratories Nonnuclear Fabrication Facility Construction Requirements***

Requirement	Consumption
Material/Resource	
Electrical energy (MWh)	46.8
Peak electrical demand (MWe)	2.5
Concrete (m^3)	12,800
Steel (t)	5,440
Gasoline, diesel, and lube oil (L)	2,600,000
Industrial gases [54] (m^3)	NA
Water (L)	2,200,000
Land (ha)	9
Employment	
Total employment (worker years)	781
Peak employment (workers)	379
Construction period (years)	3

Table 3.4.2.5-2.-- ***Sandia National Laboratories Nonnuclear Fabrication Facility Surge Operation Annual Requirements***

Requirement	Consumption
Resource	
Electrical energy (MWh)	39,700
Peak electrical demand (MWe)	6.2
Gasoline and diesel fuel (L)	None

Natural gas [55] (m^3)	3,270,000
Water (L)	893,000,000
Plant Footprint (ha)	9
Employment (Workers)	1,160

Waste Management. The SNL existing waste management infrastructure can be applied to manage and treat all anticipated waste streams from this alternative. All hazardous and nonhazardous wastes generated and any radioactive or mixed wastes generated under upset conditions at SNL facilities would be managed in accordance with all applicable Federal and state waste regulations. The wastes anticipated from the estimated workload would not require significant modification of the existing SNL waste management infrastructure. Waste generation for construction and operation of the SNL Nonnuclear Fabrication Facility is shown in table 3.4.2.5-3.

Table 3.4.2.5-3.-- ***Sandia National Laboratories Nonnuclear Fabrication Facility Waste Volumes***

Category	Annual Average Volume Generated from Construction (m^3)	Annual Volume Generated from Surge Operations [56] (m^3)	Annual Volume Effluent from Surge Operations (m^3)
Low-Level [57]			
Liquid	None	None	None
Solid	None	None	None
Mixed Low-Level			
Liquid	None	None	None
Solid	None	None	None
Hazardous			
Liquid	0.11	15	15
Solid	23	17	17
Nonhazardous (Sanitary)			
Liquid	6,160 [58]	291,470	291,470 [59]
Solid	236	7,880	3,940 [60]
Nonhazardous (Other)			
Liquid	383 [61]	Included in sanitary	Included in sanitary
Solid	5	Included in sanitary	Included in sanitary

3.4.3 Pit Fabrication and Intrusive Modification Pit Reuse Alternatives

This capability, hereafter referred to as pit fabrication, includes all activities necessary to fabricate new pits, to modify the internal features of existing pits (intrusive modification), and to recertify or requalify pits. Processes for fabrication of replacement pits and modification of existing pits may involve handling, storing, and shipping HEU components. It is assumed that HEU components for

assembly into replacement pits will be fabricated at Y-12 and shipped to LANL. Uranium components removed from pits that are to be replaced would be processed to remove residual plutonium, packaged, and shipped to Y-12.

For the base case analysis, workload requirements are assumed to be at a level necessary to maintain competence and to replace components destroyed during surveillance testing. This base case production rate is approximately 20 pits per year. In order to ensure that DOE is able to support the national security mission, equipment would be installed to provide the capability to fabricate one each of every pit type in the post-2005 stockpile. This concept is called capability-based capacity. Operating this array of equipment 5 days per week, on a single shift, provides an annual capacity of approximately 50 pits of, at most, 2 different types.

There are two alternative sites for pit fabrication: SRS and LANL. Nonintrusive modification pit reuse, which is an inherent capability of the pit fabrication facility, includes the processes and systems necessary to make modifications to the external features of a pit, if necessary, and to recertify the pit for reuse in a weapon.

3.4.3.1 *No Action*

Under the No Action alternative, DOE would continue to use existing R&D capabilities at LANL and LLNL. LANL maintains a limited capability to fabricate plutonium components using its Plutonium Research and Development Facility and performs surveillance operations on plutonium components returned from the stockpile. In addition, less extensive capabilities would continue at LLNL to support material and process technology development. Under No Action, DOE would not have the capability to perform pit fabrication to meet the requirements described in section 3.1 for the base case.

3.4.3.2 *Reestablish at Los Alamos National Laboratory*

This alternative would reconfigure the Plutonium Facility at LANL to fulfill the pit fabrication mission and the intrusive modification pit reuse mission. Pit manufacturing would consist of the following functions: pit fabrication, plutonium processing, waste processing, analytical chemistry, physical vapor deposition coatings, and storage. A more detailed discussion of this alternative is provided in appendix section A.3.3.1.

Construction. This alternative would locate pit manufacturing in existing facilities within five technical areas (TAs -55, -3, -8, -50, and -54). *(graphic not available)* Figure 3.4.3.2-1 shows the LANL TAs. The pit fabrication/modification and plutonium processing activities would be located in the existing Plutonium Facility (PF-4), which is situated within the controlled access area of TA-55. The 300 Area of PF-4 would be used to fabricate plutonium components and to assemble those components into pits. Existing equipment would be retained as much as possible, but some equipment would be upgraded to production quality. Other TAs would provide waste processing, analytical chemistry, and other support functions. Figure 3.4.3.2-2 shows the plot plan for the pit fabrication/modification and plutonium processing facilities in TA-55. Table 3.4.3.2-1 shows construction requirements for the LANL Pit Fabrication Facility.

Table 3.4.3.2-1.-- ***Los Alamos National Laboratory Pit Fabrication Facility Construction Requirements***

Requirement	Consumption
Material/Resource	
Electrical energy (MWh)	Minimal
Peak electrical demand (MWe)	Minimal
Concrete (m^3)	Minimal
Steel (t)	Minimal
Gasoline, diesel, and lube oil (L)	Minimal
Industrial gases [62] (m^3)	Minimal
Water (L)	Minimal
Land (ha)	NA [63]
Employment	
Total employment (worker years)	216
Peak employment (workers)	138
Construction period (years)	3

Operation. This alternative would consolidate the pit fabrication and modification processes, receiving pits from offsite and shipping new or rebuilt pits to the Weapons Assembly Facility. The pits received from offsite would be routed to a disassembly area. The plutonium metal from disassembled pits would be purified before transfer to the fabrication area. Residues generated in the disassembly/metal purification areas would primarily consist of chloride salts, crucibles, and chloride-contaminated scrap. The bulk of the residual plutonium would be purified and converted to plutonium metal in the chloride recovery area. Recovered plutonium metal would also be sent to the fabrication area. During fabrication, plutonium metal would be cast into the desired near-net shape and machined to the final shape with desired tolerances. The finished components would be assembled with other nonplutonium materials into the new pit component. These new pits would be sent to the Weapons Assembly Facility. During the casting and machining operations, a number of residues would be generated that require processing and would subsequently undergo nitrate aqueous recovery operations. In nitrate aqueous recovery, the residues are purified and converted to oxide for return to the reduction operations. Solid and liquid wastes from processing areas would be routed to waste management facilities for processing into a disposable waste form. Analytical laboratories provide chemical analyses of plutonium metal, oxides, solutions, and wastes. Table 3.4.3.2-2 shows the surge operating requirements for the LANL Pit Fabrication and Intrusive Modification Pit Reuse Facility.

Table 3.4.3.2-2.-- ***Los Alamos National Laboratory Pit Fabrication Facility Surge Operation Annual Requirements***

Requirement	Consumption
Resource	
Electrical energy (MWh)	5,480
Peak electrical demand (MWe)	0.7
Liquid fuel (L)	None
Natural gas [64] (m^3)	30,900

Water (L)	30,200,000
Plant Footprint (ha)	NA [65]
Employment (Workers)	628 [66]

Waste Management. The existing LANL waste management infrastructure can be applied to manage and treat all anticipated waste streams from this alternative. All hazardous, radioactive, and mixed waste generated at LANL facilities would be managed in accordance with all applicable Federal and state regulation. The wastes anticipated from the estimated workloads would not require significant modifications of the existing LANL waste management infrastructure. Waste generation for construction and operation of the LANL Pit Fabrication Facility is shown in table 3.4.3.2-3.

Table 3.4.3.2-3.-- ***Los Alamos National Laboratory Pit Fabrication Facility Waste Volumes (80 Pits Per Year)***

Category	Annual Average Volume Generated from Construction (m^3)	Annual Volume Generated from Surge Operation (m^3)	Annual Volume Effluent from Surge Operation (m^3)
Transuranic			
Liquid	None	5	None
Solid	6 [67]	43	60
Mixed Transuranic			
Liquid	None	None	None
Solid	None	2	2
Low-Level			
Liquid	None	15	None
Solid	12 [68]	386	393
Mixed Low-Level			
Liquid	None	None	None
Solid	None	None	None
Hazardous			
Liquid	0.06	2	2
Solid	51	None	None
Nonhazardous (Sanitary)			
Liquid	None	12,300 [69]	12,300
Solid	None	552 [70]	552
Nonhazardous (Other)			
Liquid	None	Included in sanitary	Included in sanitary
Solid	26 [71]	Included in sanitary	Included in sanitary

3.4.3.3 *Reestablish at Savannah River Site*

This alternative would establish a pit fabrication and reuse facility at SRS within existing hardened facilities, but with new equipment and systems. The facility would fulfill the replacement pit fabrication mission and the intrusive and nonintrusive modification pit reuse missions. This alternative would consolidate all pit fabrication and modification processes, receiving pits from offsite and shipping new or rebuilt pits off site to the Weapons Assembly Facility. Nonnuclear pit components would be manufactured at other DOE sites and shipped to SRS for assembly into pits. The receiving, handling, and disposition of surplus plutonium could also be consolidated with the plutonium processing facilities. A more detailed discussion of this alternative is provided in appendix section A.3.3.2.

Construction. Facilities are available at the SRS separation areas, F-Area, and H-Area, which could house, in hardened structures, all the process functions required for the manufacture of plutonium pits (figure 3.4.3.3-1). Pit fabrication would be located in Building 232-H, and plutonium processing would be located in the F-Canyon facilities.

Building 232-H is primarily a hardened facility that is used for tritium processing and handling operations that are being relocated to the Replacement Tritium Facility. Adequate space would be available for the Pit Fabrication Facility following removal of some existing equipment and piping systems. New equipment and systems would be required for the Pit Fabrication Facility.

F-Canyon facilities have adequate noncontaminated hardened areas to house the plutonium processing functions. The Plutonium Storage Facility and the New Special Recovery Facility, which have never been started up, would be used in addition to a third level F-Canyon building production space that has been decontaminated. Many of the unused glove boxes in these facilities could be used as is or with minor modifications. Table 3.4.3.3-1 shows construction requirements, and figure 3.4.3.3-2 provides a site plan for the SRS Pit Fabrication and Intrusive Modification Pit Reuse Facility.

Table 3.4.3.3-1.-- ***Savannah River Site Pit Fabrication Facility Construction Requirements***

Requirement	Consumption
Material/Resource	
Electrical energy (MWh)	15
Peak electrical demand (MWe)	0.37
Concrete (m^3)	1,600
Steel (t)	249
Gasoline, diesel, and lube oil (L)	175,000
Industrial gases [72] (m^3)	3,780
Water (L)	30,000,000
Land (ha)	NA [73]
Employment	
Total employment (worker years)	801
Peak employment (workers)	288

Construction period (years)	5

Operation. Table 3.4.3.3-2 shows the surge operating requirements for the SRS Pit Fabrication and Intrusive Modification Pit Reuse Facility. Specific processes required for pit fabrication are discussed in appendix section A.3.3.2.

Table 3.4.3.3-2.-- ***Savannah River Site Pit Fabrication Facility Surge Operation Annual Requirements***

Requirement	Consumption
Resource	
Electrical energy (MWh)	9,700
Peak electrical demand (MWe)	1.6
Liquid fuel (L)	28,400
Natural gas [74] (m^3)	None
Water (L)	46,200,000
Coal (t)	1,090
Plant Footprint (m^3)	NA [75]
Employment (Workers)	813

Pit disassembly, plutonium purification, and residue processing would be performed in existing hardened facilities in the F-Area. These facilities include New Special Recovery, which is equipped to dissolve and purify plutonium, a new reduction (metal preparation) facility in Building 221-F, and the Plutonium Storage Facility. Existing facilities in the F-Area are sized for a large yearly throughput (2 to 5 metric tons [t] [2.2 to 5.5 short tons {tons}]), if required. Also available onsite is the Defense Waste Processing Facility, which would be used for disposal of americium that is a byproduct of plutonium purification. Analytical laboratories in the F-Canyon Area are available to support process control requirements. These facilities in F-Area are operated by the DOE Environmental Management Program.

The plutonium fabrication process in Building 232-H would be an abbreviated version of the process used by the Rocky Flats Plant. Though there are several pit types, the process for each pit type is basically the same. The process consists of casting parts to the near-net shape, machining the surfaces of the casting to achieve the final shape, and performing tests on the completed parts to ensure suitability. After this inspection, the plutonium components are cleaned and assembled with the nonnuclear components to be built into the pit and then welded together into one unit. With the plutonium encapsulated, it may then be safely removed from the glove box, certified, and stored or shipped offsite, as needed.

Nonnuclear components used in the new pits would be received from offsite. After inspection, these parts would be stored in Building 704-55H until needed for either newly fabricated or reused pits.

For the nonintrusive modification pit reuse function, the pit is not disassembled. The entire pit is received through the weapons retirement/disassembly process. The pit is then cleaned, inspected and, if necessary, the exterior of the pit is modified. No plutonium is exposed in the nonintrusive modification pit reuse function.

Waste Management. The existing SRS waste management infrastructure can be applied to manage and treat all anticipated waste streams from this alternative. All hazardous, radioactive, and mixed waste generated at SRS facilities would be managed in accordance with all applicable Federal and state regulations. The wastes anticipated from the estimated workloads would not require significant modifications of the existing SRS waste management infrastructure. The plutonium recovery process would generate a liquid transuranic (TRU) waste that SRS would manage as a high-specific activity waste. This waste would be managed in accordance with the SRS HLW management plan and would result in HLW glass logs and LLW saltstone. Radiographic inspection would generate a low-specific activity waste stream that would include development chemicals such as silver. This stream would be treated as mixed LLW. Waste generation for construction and operation of the SRS Pit Fabrication Facility is shown in table 3.4.3.3-3.

Table 3.4.3.3-3.-- ***Savannah River Site Pit Fabrication Waste Volumes (120 Pits Per Year)***

Category	Annual Average Volume Generated f rom Construction (m^3)	Annual Volume Generated from Surge Operations (m^3)	Annual Volume Effluent from Surge Operations (m^3)
Transuranic			
Liquid	None	28 [76]	None
Solid	None	129 [77]	129b
Mixed Transuranic			
Liquid	None	None	None
Solid	None	11	11
Low-Level			
Liquid	None	80 [78]	None
Solid	None	88 [79]	34
Mixed Low-Level			
Liquid	None	None	None
Solid	None	None	None
Hazardous			
Liquid	<0.01	<1	None
Solid	8 [80]	None	<0.01 [81]
Nonhazardous (Sanitary)			
Liquid	3,020	46,160	46,140 [82]

Solid	23	1,450	1,580
Nonhazardous (Other)			
Liquid	None	None	None
Solid	500 [83]	1,450 [84]	None

3.4.4 Secondary and Case Fabrication Alternatives

The secondary and case fabrication mission includes all activities to support fabrication, surveillance, inspection, and testing of secondaries and components. Functional capabilities for these services include operations to physically and chemically process, machine, inspect, assemble, and disassemble secondary and case materials. Materials include depleted uranium, enriched uranium, uranium alloys, isotopically enriched lithium hydride and lithium deuteride, and other materials. The concept of capability-based capacity discussed in section 3.4.3 applies to this section. Alternative sites considered for stockpile management secondary activities are ORR, LANL, and LLNL.

When comparing data between site alternatives, it is important to note that there are differences in the facility designs. The Y-12 alternative includes all the necessary support facilities to conduct the missions, not just the production and storage facilities. The LANL and LLNL alternatives only consider the incremental changes for operating the production facilities. The actual production footprint size of each alternative is almost identical; however, the production capacities vary between site alternatives. For example, base case, multiple-shift capacities at Y-12 and LANL are about 150 units, whereas at LLNL the equivalent production capability would be about 50 units. This creates significant differences in some of the data.

3.4.4.1 *No Action*

Under No Action, ORR would continue secondary and case fabrication. Y-12 maintains the capability to produce and assemble uranium and lithium components, to recover uranium and lithium materials from the component fabrication process and disassembled weapons, and to produce secondaries, cases, and related nonnuclear weapons components.

3.4.4.2 *Downsize at Oak Ridge Reservation*

This alternative would be based on downsizing the existing secondary and case fabrication facilities at Y-12 (figure 3.4.4.2-1) consistent with future requirements. The downsized facilities would only require approximately 14 percent of the existing Y-12 floor space for the DP mission, while EM missions would assume the majority of the remaining area. The Y-12 secondary and case fabrication facilities would be divided into the following four factories:

- Enriched uranium factory for processing enriched uranium
- Depleted uranium factory for processing depleted uranium and uranium alloys
- Special materials factory for processing lithium compounds and other materials
- Nonnuclear factory for processing nonnuclear secondary and case parts and materials

This alternative is discussed in more detail in appendix section A.3.2.1.

Construction . This alternative consists of five principal production buildings, one shared production facility, and a number of office, utility, and changehouse facilities. Buildings 9204-2 and 9201-5W would be placed in cold standby for potential activation should unforeseen capacity needs arise. Re-activation of these buildings would require separate NEPA evaluation. Figure 3.4.4.2-2 shows the location of the Y-12 secondary and case fabrication facilities. There would be no new facility construction at Y-12 to support the secondary and case fabrication mission. Modifications to the existing buildings would be required for implementation of the alternate secondary and case fabrication mission and to upgrade the buildings to meet natural phenomena requirements. The modifications would be as follows:

- Building 9996: Connections between the building and the A-2 Wing of Building 9212 complex would be strengthened.
- Building 9212: Modifications would be made to numerous columns, knee braces, and cross braces to provide proper stiffness and load distribution.
- Buildings 9215: The M-Wing area of this building would be converted primarily for enriched uranium storage. The high case would require some machine tools to be in cold standby. The F-Wing area would house the can shop, to be relocated from Building 9201-1. The roof deck would be tack welded to existing purlins, additional corner supports would be added to this area of the roof, and four new scuppers would be added.
- Building 9998: This building houses the depleted uranium/binary foundry area. The installation of a 3,175-t (3,500-ton) press would be required in F-Area. Enriched uranium machining and the associated dimensional inspection would be relocated to the H2-Area. Other additions include the plasma-spray coating and ceramic machining operations to be located in the G3-Area. Some new equipment for special materials processing would also be installed in the G3-Area. Four steel columns and two steel girders would be strengthened by adding additional steel. Roof bracing would be added and additional tack welding of the roof support steel would be done.
- Building 9201-5N: Tack weld roof deck to roof, provide additional roof corner support, and install scuppers.
- Building 9204-2E: The first floor of this building would have a lithium pro (MWh)

Table 3.4.4.2-1 - ***Y-12 Plant Secondary and Case Fabrication Facility Construction Requirements***

Requirement	Consumption
Material/Resource	
Electrical energy (MWh)	2.7
Peak electrical demand (MWe)	0.2
Concrete (m^3)	100
Steel (t)	20
Gasoline, diesel, and lube oil (L)	10,000
Industrial gases(m^3)[85]	300
Water (L)	2,000,000
Land (ha)	NA[86]
Employment[87]	
Total employment (worker years)	72

Peak employment (workers)	14
Construction period (years)	6

Operation. Table 3.4.4.2-2 shows the surge operating requirements for the Y-12 Secondary and Case Fabrication Facility.

Table 3.4.4.2-2.-- ***Y-12 Plant Secondary and Case Fabrication Facility Surge Operation Annual Requirements***

Requirement	Consumption
Resource	
Electrical energy (MWh)	118,000
Peak electrical demand (MWe)	19
Liquid fuel (L)	250,000
Natural gas [88] (m^3)	17,000,000
Water (L)	1,510,000,000
Coal (t)	500
Plant Footprint (ha)	NA [89]
Employment (Workers)	4,508 [90]

Waste Management. The ORR existing waste management infrastructure can be applied to manage and treat all anticipated waste streams from this alternative. All hazardous, radioactive, and mixed wastes generated at Y-12 facilities would be managed in accordance with all applicable Federal and state waste regulations. The wastes anticipated from the estimated workloads would not require significant modification of the existing ORR waste management infrastructure. Waste generation for construction and operation of the Y-12 secondary and case fabrication alternative is shown in table 3.4.4.2-3.

Table 3.4.4.2-3.-- ***Y-12 Plant Secondary and Case Fabrication Facility Waste Volumes***

Category	Annual Average Volume Generated from Construction (m^3)	Annual Volume Generated from Surge Operations (m^3)	Annual Volume Effluent from Surge Operations (m^3)
Low-Level			
Liquid	None	320	None
Solid	8	1,120 [91]	570 [92]
Mixed Low-Level			
Liquid	None	3,400	3,400

Solid	1	92 [93]	92
Hazardous			
Liquid	None	Included in mixed	Included in mixed
Solid	2	Included in mixed	Included in mixed
Nonhazardous (Sanitary)			
Liquid	27	320,000	319,400 [94]
Solid	30 [95]	13,500 [96]	7,670 [97]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	2	10,000 [98]	Included in sanitary

3.4.4.3 Relocate to Los Alamos National Laboratory

This alternative would establish a secondary and case fabrication capability using the processes proven at Y-12 and would use facilities in 11 existing buildings. The LANL Secondary and Case Fabrication Facility operations would fall into the following four categories:

- Enriched uranium operations
- Depleted uranium and uranium alloy operations
- Special materials fabrication for lithium compounds and other materials
- Nonnuclear fabrication and processing for nonnuclear secondary and case parts and materials

This alternative is discussed in more detail in appendix section A.3.2.2.

Construction. Secondary and case fabrication at LANL would utilize existing facilities within the boundaries of TAs -3, -8, -50, -55, and -54. Facilities within each of these TAs include the TA-3 Sigma complex (Buildings SM-35, SM-66, and SM-141), the TA-3 Chemistry and Metallurgy Research Building (Building SM-29), the TA-3 Main Machine Shop (Buildings SM-39 and SM-102), the TA-8 Nondestructive Evaluation Facility (Buildings 22 and 23), the TA-55 Nuclear Material Storage Facility for overflow capacity, the TA-50 Liquid Radioactive Waste Management Facility, and the TA-54 Solid Radioactive Waste Management Area. These areas are shown in figure 3.4.4.3-1.

Figure 3.4.4.3-2 shows the major structures located in TA-3. The buildings shown on this plot plan for use in stockpile stewardship and management operations are SM-29, SM-35, SM-39, SM-66, SM-102, and SM-141. Modifications would be required for the following facilities:

- Renovations to Wings 2, 4, and 9 of the Chemistry and Metallurgy Research Building
- Main machine shop change room and ventilation upgrades

- Sigma complex lithium forming, machining, and inspection
- Sigma complex lithium purification and storage

Modification to the LANL facilities to perform the stockpile management secondary and case fabrication mission would require approximately 7 years for design, construction, mission transfer, and operational startup. Table 3.4.4.3-1 shows construction requirements for the LANL Secondary and Case Fabrication Facility.

Table 3.4.4.3-1.-- ***Los Alamos National Laboratory Secondary and Case Fabrication Facility Construction Requirements***

Requirement	Consumption
Material/Resource	
Electrical energy (MWh)	4,130
Peak electrical demand (MWe)	0.75
Concrete (m^3)	245
Steel (t)	54
Gasoline, diesel, and lube oil (L)	22,700
Industrial gases [99] (m^3)	11,500
Water (L)	4,160,000
Land (ha)	NA [100]
Employment	
Total employment (worker years)	205
Peak employment (workers)	55
Construction period (years)	4

Operation. Table 3.4.4.2-2 shows the surge operating requirements for the LANL Secondary and Case Fabrication Facility.

Table 3.4.4.3-2.-- Los Alamos National Laboratory Secondary and Case Fabrication Facility Surge Operation Annual Requirements

Requirement	Consumption
Resource	
Electrical energy (MWh)	36,000
Peak electrical demand (MWe)	5
Liquid fuel (L)	100,000
Natural gas [101] (m^3)	None
Water (L)	55,000,000
Plant Footprint (ha)	NA [102]
Employment (Workers)	523 [103]

Table 3.4.4.3-3.-- ***Los Alamos National Laboratory Secondary and Case Fabrication Facility Waste Volumes***

Category	Annual Average Volume Generated from Construction (m^3)	Annual Volume Generated from Surge Operations (m^3)	Annual Volume Effluent from Surge Operations (m^3)
Low-Level			
Liquid	None	192	None
Solid	134	690	349 [104]
Mixed Low-Level			
Liquid	None	30	**30**
Solid	10	108	**108**
Hazardous			
Liquid	None	60	60
Solid	37	216	216
Nonhazardous (Sanitary)			
Liquid	890	20,240	20,370
Solid	120	1,160	639 [105]
Nonhazardous (Other)			
Liquid	Included in sanitary	None	None
Solid	10 [106]	3,000	3,000

Waste Management. The LANL existing waste management infrastructure can be applied to manage and treat all anticipated waste streams from this alternative. All hazardous, radioactive, and mixed wastes generated at LANL facilities would be managed in accordance with all applicable Federal and state waste regulations. The wastes anticipated from the estimated workloads would not require significant modification of the existing LANL waste management infrastructure. Waste generation for construction and operation of the LANL secondary and case fabrication alternative is shown in table 3.4.4.3-3.

3.4.4.4 Relocate to Lawrence Livermore National Laboratory

This alternative would establish a secondary and case fabrication capability using the processes proven at Y-12, and would use facilities in existing buildings. The LLNL Secondary and Case Fabrication Facility operations are the same as those described in section 3.4.4.3. This alternative is discussed in more detail in appendix section A.3.2.3.

Construction. Manufacturing and assembly of the secondaries and cases would take place at the Livermore Site (figure 3.4.4.4-1) in the buildings shown on the LLNL site plan, figure 3.4.4.4-2. The secondary and case fabrication facilities at LLNL would principally involve the following buildings with minor modifications:

- Building 175 for E-beam melt facility for uranium alloy billets
- Building 231 for uranium foundry and metal working for uranium alloys
- Building 241 for special material fabrication (lithium and other special materials)
- Building 321 for machining of depleted uranium and uranium alloys and fabrication of nonnuclear components
- Building 332 as the Main Enriched Uranium Piece Part Fabrication Facility and the Main A/D Quality Evaluation Facility
- Building 334 as an extension to Building 332

In addition, the secondary and case fabrication functions would share facilities in several buildings with other LLNL programs for sample test activities. While this alternative would not require new building construction, it would require some modifications and building renovations, and the construction of a 167 m 2 (1,800 ft^2) steel frame covered space within the Superblock protected area to house the enriched uranium inventory. Table 3.4.4.4-1 shows construction requirements for the LLNL Secondary and Case Fabrication Facility.

Table 3.4.4.4-1.-- ***Lawrence Livermore National Laboratory Secondary and Case Fabrication Facility Construction Requirements***

Requirement	Consumption
Material/Resource	
Electrical energy (MWh)	3,500
Peak electrical demand (MWe)	0.4
Concrete (m^3)	612
Steel (t)	73
Gasoline, diesel, and lube oil (L)	908,000
Industrial gases [107] (m^3)	142
Water (L)	8,710,000
Land (ha)	NA [108]
Employment	
Total employment (worker years)	330
Peak employment (workers)	130
Construction period (years)	3

Operation. Table 3.4.4.4-2 shows the surge operating requirements for the LLNL Secondary and Case Fabrication Facility.

Table 3.4.4.4-2.- ***Lawrence Livermore National Laboratory Secondary and Case Fabrication Facility Surge Operation Annual Requirements***

Requirement	Consumption
Resource	
Electrical energy (MWh)	15,000
Peak electrical demand (MWe)	2.0
Liquid fuel (L)	85,200
Natural gas [109] (m^3)	566,000
Water (L)	194,000,000
Plant Footprint (ha)	NA [110]
Employment (Workers)	760 [111]

Waste Management. The LLNL existing waste management infrastructure can be applied to manage and treat all anticipated waste streams from this alternative. All hazardous, radioactive, and mixed wastes generated at LLNL facilities would be managed in accordance with all applicable Federal and state waste regulations. The wastes anticipated from the estimated workload would not require significant modifications to the existing LLNL waste management infrastructure. Waste generation for construction and operation of the LLNL secondary and case fabrication alternative is shown in table 3.4.4.4-3.

Table 3.4.4.4-3.-- *Lawrence Livermore National Laboratory Secondary and Case Fabrication Facility Waste Volumes*

Category	Annual Average Volume Generated from Construction (m^3)	Annual Volume Generated from Surge Operations (m^3)	Annual Volume Effluent from Surge Operations (m^3)
Low-Level			
Liquid	None	105	None
Solid	5	370	304
Mixed Low-Level			
Liquid	None	550	550
Solid	None	12	12
Hazardous			
Liquid	11	540	540
Solid	41	18	18
Nonhazardous (Sanitary)			
Liquid	5,050	102,000	102,000
Solid	2,820	4,320	4,320
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	255	3,200 [112]	None

3.4.5 High Explosives Fabrication Alternatives

The HE fabrication mission is described in two functional areas: HE main charge fabrication and small HE component fabrication. Capabilities required include manufacturing process development, formulation, synthesis, main charge manufacturing (pressing, machining, subassembly, receiving/storage, quality assurance, and disposition), and energetic component manufacture. The HE fabrication mission supports the production aspect of stockpile management and also supports HE surveillance and some stockpile stewardship activities.

3.4.5.1 No Action

Under No Action, Pantex would continue, in its current configuration, the fabrication and surveillance of HE components for nuclear weapons. LANL and LLNL would continue to perform weapons HE R&D, surveillance, and HE safety studies.

3.4.5.2 Downsize at Pantex Plant

The Pantex HE fabrication alternative would downsize and consolidate current HE operations and facilities. This alternative would be considered only in conjunction with maintaining the weapons A/D mission at Pantex. Although there is no requirement for collocation of weapons A/D and HE fabrication, it would not be practical to maintain Pantex operations solely for HE fabrication. This alternative is discussed in more detail in appendix section A.3.5.1.

Construction. Figures 3.4.5.2-1, 3.4.5.2-2, and 3.4.5.2-3 show Zones 11 and 12 and the existing facilities within these zones that are part of the HE fabrication proposal. Only minor modifications to existing facilities within Zones 11 and 12 would be required. The Pantex HE fabrication alternative would use existing buildings and facilities within Zones 4, 11, 12, FS-11, FS-22, FS-24, and the Burning Ground. Table 3.4.5.2-1 shows construction requirements for the Pantex HE Fabrication Facility.

Operation. The HE fabrication process comprises HE main charge fabrication, small HE component fabrication, HE formulation and synthesis, and HE testing and characterization. Processes used include isostatic pressing, machining, mechanical punch and die pressing, laser welding, explosive-extrusion, mechanical assembly, dimensional checking, and a variety of testing methodologies. There would be no change in processes or operations for HE fabrication from existing Pantex operations. Table 3.4.5.2-2 shows the annual Pantex HE Fabrication Facility surge operating requirements.

Table 3.4.5.2-1.-- ***Pantex Plant High Explosives Fabrication Facility Construction Requirements***

Requirement	Consumption
Material/Resource	
Electrical energy (MWh)	257
Peak electrical demand (MWe)	2
Concrete (m^3)	356
Steel (t)	6
Gasoline, diesel, and lube oil (L)	12,200

Industrial gases [113] (m^3)	258
Water (L)	644,000
Land (ha)	NA [114]
Employment	
Total employment (worker years)	46
Peak employment (workers)	29
Construction period (years)	3

Table 3.4.5.2-2.-- ***Pantex Plant High Explosives Fabrication Facility Surge Operation Annual Requirements***

Requirement	Consumption
Resource	
Electrical energy (MWh)	3,250
Peak electrical demand (MWe)	1
Liquid fuel (L)	55,600
Natural gas [115] (m^3)	500,000
Water (L)	12,500,000
Plant Footprint (ha)	NA [116]
Employment (Workers]	37 [117]

Waste Management. The existing Pantex waste management infrastructure can be applied to manage and treat all anticipated waste streams from this alternative. All hazardous, nonhazardous, and a minimal quantity of radioactive waste generated at Pantex facilities would be managed in accordance with all applicable Federal and state waste regulations. The wastes anticipated from the estimated workloads would not require significant modification of the existing Pantex waste management infrastructure. Waste generation for construction and operation of the Pantex HE fabrication alternative is shown in table 3.4.5.2-3.

Table 3.4.5.2-3.-- ***Pantex Plant High Explosives Fabrication Facility Waste Volumes***

Category	Annual Average Volume Generated from Construction (m^3)	Annual Volume Generated from Surge Operations (m^3)	Annual Volume Effluent from Surge Operations (m^3)
Low-Level			
Liquid	None	None	None
Solid	None	Minimal	Minimal
Mixed Low-Level			

Liquid	None	None	None
Solid	None	None	None
Hazardous			
Liquid	None	0.23	0.23
Solid	0.06	30	30
Nonhazardous (Sanitary)			
Liquid	146	7,120	7,120
Solid	None	17	8 [118]
Nonhazardous (Other)			
Liquid	Included in sanitary	None	None
Solid	2 [119]	Included in sanitary	Included in sanitary

3.4.5.3 Relocate to Los Alamos National Laboratory

This alternative would transfer HE operations to LANL from Pantex during a 2-year transition period, during which Pantex would continue to support the stockpile. This alternative would use existing LANL R&D facilities, which have sufficient capacity to accommodate the required workload. This alternative is discussed in more detail in appendix section A.3.5.2. The option to share the HE mission with LLNL is bounded by this analysis and is not discussed further.

Construction. LANL HE fabrication process capability is already established. HE fabrication and storage functions would be supported in existing facilities at LANL TAs -9, -16, and -37 (figure 3.4.5.3-1). Since LANL HE plant facilities already exist and have sufficient capacity for stockpile management requirements, no new building construction and no significant modifications would be required. As indicated in table 3.4.5.3-1, there would be minimal resource requirements other than personnel for modification and transition, and no waste would be generated. Figure 3.4.5.3-2 shows the existing major HE fabrication facilities at TA-16. Additional TAs would provide production support and testing functions.

Operation. The HE fabrication alternative at LANL would operate in the same manner as current HE fabrication processes and operations. HE processing facilities at LANL were designed and built for production-scale operations and were operated as production facilities for many years. The current baseline production technologies in use at Pantex would be used at LANL. HE processing at LANL includes HE storage; HE synthesis; HE formulations, pressing, machining, assembly, and subassembly of HE devices; quality assurance activities; and HE disposal. Operations would also continue to provide environmental, safety, and performance testing of HE and HE assemblies. Table 3.4.5.3-2 shows the annual LANL HE Fabrication Facility surge operating requirements.

Table 3.4.5.3-1.-- ***Los Alamos National Laboratory High Explosives Fabrication Facility Construction Requirements***

Requirement	Consumption
Material/Resource	
Electrical energy (MWh)	Minimal
Peak electrical demand (MWe)	Minimal
Concrete (m^3)	Minimal
Steel (t)	Minimal
Gasoline, diesel, and lube oil (L)	Minimal
Industrial gases [120] (m^3)	Minimal
Water (L)	Minimal
Land (ha)	NA [121]
Employment	
Total employment (worker years)	77
Peak employment (workers)	46
Construction period (years)	2

Table 3.4.5.3-2.-- ***Los Alamos National Laboratory High Explosives Fabrication Facility Surge Operation Annual Requirements***

Requirement	Consumption
Resource	
Electrical energy (MWh)	5,600
Peak electrical demand (MWe)	1
Liquid fuel (L)	94,600
Natural gas [122] (m^3)	3,650,000
Water (L)	13,000,000
Plant Footprint (ha)	NA [123]
Employment (Workers)	200 [124]

Waste Management. The existing LANL waste management infrastructure can be applied to manage and treat all anticipated waste streams from this alternative. All hazardous, nonhazardous, and a minimal quantity of radioactive waste generated at LANL facilities would be managed in accordance with all applicable Federal and state waste regulations. The wastes anticipated from the estimated workloads would not require significant modification of the existing LANL waste management infrastructure. Waste generation for construction and operation of the LANL HE fabrication alternative is shown in table 3.4.5.3-3.

Table 3.4.5.3-3.-- ***Los Alamos National Laboratory High Explosives Fabrication Facility Waste Volumes***

Category	Annual Average Volume Generated from Construction (m^3)	Annual Volume Generated from Surge Operations (m^3)	Annual Volume Effluent from Surge Operations (m^3)
Low-Level			
Liquid	None	None	None
Solid	None	Minimal	Minimal
Mixed Low-Level			
Liquid	None	None	None
Solid	None	None	None
Hazardous			
Liquid	None	4 [125]	4
Solid	None	13	13
Nonhazardous (Sanitary)			
Liquid	None	5,900	5,880 [126]
Solid	None	Included in liquid	17
Nonhazardous (Other)			
Liquid	None	6,930 [127]	6,930
Solid	None	28	28

3.4.5.4 Relocate to Lawrence Livermore National Laboratory

The LLNL HE fabrication alternative would transfer HE fabrication activities from Pantex over a 2-year transition period, during which Pantex would continue to support the stockpile. The LLNL HE Fabrication Facility would consist of the HE technology functional area with four main functions: HE main charge fabrication, small HE component fabrication, HE formulation and synthesis, and HE testing and characterization. This alternative would use existing R&D facilities, with some minor enhancements and modifications. The LLNL HE fabrication alternative is discussed in more detail in appendix section A.3.5.3. The option to share the HE mission with LANL is bounded by this analysis and is not discussed further.

Construction. The LLNL HE fabrication alternative would require construction of 1 new facility and would use 23 existing buildings, 66 existing magazines, and various utilities and services at Site 300 (figure 3.4.5.4-1). The one new facility would be for storage of HE. This building would have 11,350 kg (25,000 lb) of conventional HE bulk and parts storage for a 116 m^2 (1,250 ft^2) staging capacity. Table 3.4.5.4-1 shows construction requirements for the LLNL HE Fabrication Facility.

Table 3.4.5.4-1.-- ***Lawrence Livermore National Laboratory High Explosives Fabrication Facility Construction Requirements***

Requirement	Consumption
Material/Resource	
Electrical energy (MWh)	15
Peak electrical demand (MWe)	0.2
Concrete (m^3)	190
Steel (t)	15
Gasoline, diesel, and lube oil (L)	9,500
Industrial gases [128] (m^3)	3
Water (L)	1,230,000
Land (ha)	0.8
Employment	
Total employment (worker years)	19
Peak employment (workers)	19
Construction period (years)	1

Operation. The LLNL HE fabrication alternative activities would continue using the same facilities, processes, and operations as the existing HE manufacturing conducted at the site. The current baseline technologies in use at Pantex would be used at LLNL. The production and fabrication of the HE components and materials mission would be accommodated by an incremental increase in the workload currently supported by the HE technology at LLNL. The HE processing at LLNL includes storage, synthesis, formulation, pressing, machining, assembly, and subassembly of HE devices; quality assurance activities; and HE disposal. LLNL operations would also continue to provide environmental, safety, and performance testing of HE and HE assemblies. Table 3.4.5.4-2 shows the annual LLNL HE Fabrication Facility surge operating requirements.

Table 3.4.5.4-2.-- ***Lawrence Livermore National Laboratory High Explosives Fabrication Facility Surge Operation Annual Requirements***

Requirement	Consumption
Resource	
Electrical energy (MWh)	4,300
Peak electrical demand (MWe)	1
Liquid fuel (L)	53,100
Natural gas [129] (m^3)	None
Water (L)	58,200,000
Plant Footprint (ha)	0.8 [130]
Employment (Workers)	232[131]

Waste Management. The LLNL existing waste management infrastructure can be applied to manage and treat all anticipated waste streams from this alternative. All hazardous, nonhazardous, and a minimal quantity of radioactive waste generated at LLNL facilities would be managed in accordance with all applicable Federal and state waste regulations. The wastes anticipated from the estimated

workloads would not require significant modification of the existing LLNL waste management infrastructure. Waste generation for construction and operation of the LLNL HE fabrication alternative is shown in table 3.4.5.4-3.

Table 3.4.5.4-3.-- ***Lawrence Livermore National Laboratory High Explosives Fabrication Facility Waste Volumes***

Category	Annual Average Volume Generated from Construction (m^3)	Annual Volume Generated Surge Operations (m^3)	Annual Volume Effluent from Surge Operations (m^3)
Low-Level			
Liquid	None	None	None
Solid	None	Minimal	Minimal
Mixed Low-Level			
Liquid	None	None	None
Solid	None	None	None
Hazardous			
Liquid	1	3	3
Solid	2	54	54
Nonhazardous (Sanitary)			
Liquid	454	7,270	7,250 [132]
Solid	11	69	55 [133]
Nonhazardous (Other)			
Liquid	946	568	566
Solid	8 [134]	36	20

---

1 Surveillance is included in all capabilities.

2 Includes nonintrusive modification pit reuse and the option of strategic reserve storage of plutonium and HEU.

3 KCP functions would be distributed among two or three of the laboratories.

4 Staging and storage of working inventories of nuclear materials and components are included.

5 Research and development capability only.

6 Includes strategic storage of HEU reserve.

7 Cubic meters at standard temperature and pressure.

8 Laydown area for construction within existing facilities or previously disturbed areas.

NA - not applicable. PX MH 1995a.

9 Cubic meters at standard temperature and pressure.

10 Contained within existing facilities.

11 Includes 22 workers for nonintrusive modification pit reuse and 624 Work for Others employees.

NA - not applicable. PX 1995a:6; PX 1996e:1; PX DOE 1995k;
PX MH 1995a.

12 Includes 9.2 m^3 generated from A/D operations and 11.3 m^3 generated from pit reuse operations.

13 Assumes two-thirds of solid LLW is compactible by a factor of 4:1 and the liquid LLW is solidified by a factor of 2:1.

14 Includes 4.6 m^3 of concrete and 0.6 t (0.7 tons) of steel. Volume estimate made by using 0.127 m^3/t for density of steel.

15 Assumes two-thirds of solid is compactible by a factor of 4:1.

PX 1995a:6; PX DOE 1995k; PX MH 1995a.

16 Cubic meters at standard temperature and pressure.

17 Does not include 4.3 ha of new facility footprint.

NT DOE 1995b.

18 Cubic meters at standard temperature and pressure.

19 New facility footprint. Total including existing facilities is 10.5 ha.

20 Includes 22 workers for nonintrusive modification pit reuse.

NT DOE 1995b; NT DOE 1995f; NTS 1995a:3.

21 Includes 18.3 m^3 generated from A/D operations and 11.3 m^3 generated from pit reuse operations.

22 Assumes two-thirds of solid LLW is compactible by a factor of 4:1 and the liquid LLW is solidified by a factor of 2:1.

23 Includes 255 m^3 of concrete and 39 t (43 tons) of steel. Volume estimate made by using 0.127 m^3/t for density of steel.

24 Assumes two-thirds of solid is compactible by a factor of 4:1.

NT DOE 1995b; NT DOE 1995f; NTS 1995a:2; NTS 1995a:3; PX DOE 1995k.

25 Cubic meters at standard temperature and pressure.

26 Laydown area for construction within existing facilities or previously disturbed areas.

NA - not applicable. KC ASI 1995a.

27 Cubic meters at standard temperature and pressure.

28 Contained within existing facilities.

29 Includes 671 workers performing work for others.

NA - not applicable. KC ASI 1995a; KCP 1995a:2; KCP 1995a:3.

30 LLW or mixed LLW would not be generated during normal operation. However, upset conditions may result in the generation of minimal quantities of LLW or mixed LLW.

KC ASI 1995a; KCP 1995a:2; KCP 1995a:3.

31 Cubic meters at standard temperature and pressure.

32 Laydown area for construction within existing facilities or previously disturbed areas.

NA - not applicable. LANL 1995c.

33 Cubic meters at standard temperature and pressure.

34 Contained within existing facilities.

35 Total surge employment. Increase to current employment would be 194.

NA - not applicable. LANL 1995b:3; LANL 1995b:4; LANL 1995c.

36 Data for multiple shifts were not provided. Single-shift values were multiplied by 3.

37 Assumes a 350:1 wastewater to sludge ratio in the treatment of liquid sanitary wastes.

38 Assumes that two-thirds of the solid waste is compactible by a factor of 4:1.

39 2,500 gal of cleanup/washdown water, converted to cubic meters and divided by 2 for the 2-year construction period.

40 Industrial liquid wastes, which include cleaners, liquids, lube oils, and developers, are recycled.

41 Metal machining wastes, wire, scrap, and molds are recycled.

LANL 1995c.

42 Cubic meters at standard temperature and pressure.

43 Laydown area for construction within existing facilities or previously disturbed areas.

NA - not applicable. LLNL 1995f.

44 Cubic meters at standard temperature and pressure.

45 Contained within existing facilities.

46 Total surge employment. Increase to current employment would be 60.

NA - not applicable. LLNL 1995f; LLNL 1995i:2.

47 With the exception of sanitary wastes, the data for a multiple shift were determined by multiplying the single-shift values by 2.5.

48 Data were provided as 2,500 lb of acetone, 3,500 lb of toluene/methanol, 250 lb of toluene, and 270 lb of dimethyl formamide. Assuming a density of 1,000 kg/cubic meter, these were converted to cubic meters.

49 Assumes toluene/methanol wastewaters would be recycled by a distillation process. Five percent of the toluene/methanol volume is assumed for the distillation bottoms, which appear as a solid waste effluent.

50 No data provided for liquid sanitary wastes such as sewage. Assumed 50 gal/day per person, 250 days/yr operation. Number of employees used is 60. The urea waste stream was multiplied by 2.5. for three shifts.

51 LLNL does not treat sanitary wastewater. It goes to the municipal sanitary sewer system; thus, the effluent is the same as generated.

52 No data provided for solid sanitary wastes such as housekeeping trash. Assumed 0.3 ft3/day per person, 250 days/yr operation. Number of employees used is 60.

53 Assumes that two-thirds of the solid waste is compactible by a factor of 4:1.

LLNL 1995f; LLNL 1995i:2.

54 Cubic meters at standard temperature and pressure.

NA - not applicable. SNL 1995b:5; SNL 1995e.

55 Cubic meters at standard temperature and pressure.

SNL 1995b:4; SNL 1995b:5; SNL 1995e.

56 The data for a multiple shift were determined by multiplying single-shift data by 2.

57 LLW or mixed LLW would not be generated during normal operation. However, upset conditions may result in the generation of minimal quantities of LLW or mixed LLW.

58 No data provided. Assumes 25 gal/day per construction worker for 250 days/yr and 260 construction workers. Construction toilets are trucked offsite for servicing.

59 SNL sanitary wastewater goes to the city of Albuquerque sanitary sewer system; thus the effluent is the same as generated.

60 Assumes that two-thirds of the solid waste is compactible by a factor of 4:1.

61 Includes washing from flushing mechanical systems, dust control water, and blockwork, cementitious coatings.

SNL 1995b:5; SNL 1995e.

62 Cubic meters at standard temperature and pressure.

63 Laydown area for construction within existing facilities or previously disturbed areas.

NA - not applicable. LANL 1995g.

64 Cubic meters at standard temperature and pressure.

65 Contained within existing facilities.

66 Total surge employment. Increase to current employment would be 260.

NA - not applicable. LANL 1995b:4; LANL 1995g.

67 Over 3-year construction period a total of 27 t (30 tons) of associated piping and ventilation ductwork from glove boxes would be generated. For volume conversion 1500 kg/m3 was assumed.

68 Over 3-year construction period a total of 41 t (45 tons) of glove boxes and 14 t (15 tons) of associated piping ventilation and ductwork, would be generated. For volume conversion, 1500 kg/m3 was assumed.

69 Assumes 50 gal/day/person/shift with the parameters of 250 days/yr and 260 total additional employees for three shifts.

70 Assumes 0.3 ft3/day/person/shift with the parameters of 250 days/yr and 260 total additional

employees for three shifts.

71 Includes 0.15 t (0.17 tons) of steel assuming density of 0.127 m^3/t.

LANL 1995g; LANL 1996e:1.

72 Cubic meters at standard temperature and pressure.

73 Laydown area for construction within existing facilities or previously disturbed areas.

NA - not applicable. *WSRC 1995c* .

74 Cubic meters at standard temperature and pressure.

75 Contained within existing facilities.

NA - not applicable. WSRC 1995c.

76 At SRS, this would be managed as high-specific activity liquid waste, which would be combined with HLW at the Tank Farm and then processed in accordance with the High-Level Waste Management Plan as described in appendix section H.2.2. The resultant waste forms include 0.61 glass logs composed of comingled TRU waste from pit fabrication and legacy HLW, and LLW saltstone. Based on aqueous alternative process for Complex 21; denitrated water=49.3 L/kg plutonium metal processed and discarded filtrates=6.9 L/kg plutonium metal. Neutralized with 0.2 L of 50-percent caustic per kilogram of waste.

77 One-half of this volume is considered intermediate-level waste at SRS and would be disposed of in the intermediate-level waste vaults in E-Area. It is managed as TRU waste because it contains beta or gamma emitters that produce a dose equal to or greater than 200 millirem/hr at 5 cm (2 in) from an unshielded container.

78 Based on aqueous alternative process for Complex 21; 166 L of recycle water per kilogram of plutonium metal processed. Assume "recycle" water sent to Effluent Treatment Facility; recovered acid recycled.

79 Incinerable=58 m3, nonincinerable=30 m3.

80 Includes 7.6 m3 (9.9 yd3) of D&D wastes such as wall material contaminated with asbestos.

81 Treatment of liquid hazardous wastes results in solid hazardous ash. Volume reduction is 200:1.

82 Assumes 350:1 wastewater to sludge ratio for treatment of liquid sanitary waste.

83 Includes 1.5 m3 (2 yd3) of concrete and 0.18 t (0.2 tons) of steel. Includes 498 m3 (651 yd3) of D&D wastes such as ductwork, concrete, electrical wiring, and equipment.

84 Recyclable wastes.

SRS 1996a:2; WSRC 1995c.

85 Cubic meters at standard temperature and pressure.

86 Laydown area for construction within existing facilities or previously disturbed areas.

87 Does not include employment requirements for D&D of vacated buildings.

NA - not applicable. OR MMES 1996j; ORR 1995a:3; ORR 1995a:4.

88 Cubic meters at standard temperature and pressure.

89 Contained within existing facilities.

90 Includes 1,152 D&D workers, 1,980 work for others.

NA - not applicable. OR MMES 1996j; ORR 1995a:3; ORR 1995a:4.

91 Includes 10 m *3* of classified waste, 40 drums depleted uranium ash from chip oxidation (one 55-gal drum=0.2 m *3*), and 1,100 m *3* of unclassified waste.

92 Assumes 100:1 wastewater to sludge ratio for the treatment of liquid LLW followed by 2:1 for solidification. Assumes two-thirds of LLW is compactible by a factor of 4:1. LLW in drums is not compactible.

93 Includes 2 m *3* of classified waste and 90 m *3* of unclassified waste.

94 Y-12 only pretreats industrial wastewater prior to discharge to the city of Oak Ridge municipal sanitary sewer system.

95 Includes 3.4 m *3* of concrete and 4.1 t of steel.

96 Includes 5 m *3* of classified waste.

97 Assumes two-thirds of solid is compactible by a factor of 4:1.

98 Recyclable wastes.

OR MMES 1996j; ORR 1995a:4.

99 Cubic meters at standard temperature and pressure.

100 Laydown area for construction within existing facilities or previously disturbed areas.

NA - not applicable. LANL 1995b:4; LANL 1995e.

101 Cubic meters at standard temperature and pressure.

102 Contained within existing facilities.

103 Total surge employment. Increment to current employment would be 321.

NA - not applicable. LANL 1995b:4; LANL 1995e.

104 Assumes two-thirds of the solid LLW is compactible by a factor of 4:1. The wastewater to sludge ratio for liquid LLW treatment is 100:1 followed by 2:1 solidification ratio.

105 Assumes two-thirds of the solid waste is compactible by a factor of 4:1. The wastewater to sludge ratio for liquid sanitary treatment is 350:1.

106 Includes 300 t of recyclable steel and 18 t of recyclable copper.

LANL 1995b:4; LANL 1995e.

107 Cubic meters at standard temperature and pressure.

108 Laydown area for construction within existing facilities or previously disturbed areas.

NA - not applicable. LLNL 1995e.

109 Cubic meters at standard temperature and pressure.

110 Contained within existing facilities.

111 Total surge employment. Increase to current employment would be 290.

NA - not applicable. LLNL 1995e; LLNL 1995i:3; LLNL 1996i:2.

112 Recyclable wastes.

LLNL 1995e; LLNL 1995i:3.

113 Cubic meters at standard temperature and pressure.

114 Laydown area for construction within existing facilities or previously disturbed areas.

NA - not applicable. PX DOE 1995e.

115 Cubic meters at standard temperature and pressure.

116 Contained within existing facilities.

117 No overhead workers are attributable to the HE mission.

NA - not applicable. PX 1995a:5; PX 1995a:6; PX 1996e:1;

PX DOE 1995e.

118 Assumes two-thirds of solid sanitary waste is compactible by a factor of 4:1.

119 Includes 2 m3 of concrete and 0.25 t (0.28 tons) of steel that is recycled. Density of steel was assumed to be 0.127 m3/t for volume conversion.

PX 1995a:5; PX 1995a:6; PX DOE 1995e.

120 Cubic meters at standard temperature and pressure.

121 Laydown area for construction within existing facilities or previously disturbed areas.

Note: NA - not applicable. Source: LANL 1995d.

122 Cubic meters at standard temperature and pressure.

123 Contained within existing facilities.

124 Total surge employment. Increase to current employment would be 67.

NA - not applicable. LANL 1995b:4; LANL 1995d.

125 Includes high explosives process solvents and contaminated oils.

126 Assumes 350:1 wastewater to sludge ratio in treatment of liquid sanitary waste.

127 Treated process water to NPDES-permitted outfalls.

LANL 1995b:3; LANL 1995b:4; LANL 1995d.

128 Cubic meters at standard temperature and pressure.

LLNL 1995i:3; LLNL 1995j.

129 Cubic meters at standard temperature and pressure.

130 Existing facilities occupy 2,830 ha.

131 Total surge employment. Increase to current employment would be 100.

LLNL 1995i:3; LLNL 1995j.

132 Assumes 350:1 wastewater to sludge ratio for treatment of liquid sanitary waste.

133 Two-thirds of solid is compactible by a factor of 4:1.

134 Includes 7.6 m3 (9.9 yd^3) of concrete and 3 t (3.3 tons) of steel that is recycled.

LLNL 1995i:3; LLNL 1995j.

3.5 Emerging Technologies

DOE is planning to maintain the weapons stockpile using technologies that are in many cases more cost effective with less environmental impact than those used in the past. In addition to these proven baseline technologies planned for the downsized weapons complex, there are newer technologies under consideration that have the potential to offer even greater cost and environmental advantages. However, these technologies have not matured sufficiently to be included with confidence within the current baseline design. In most cases, new technologies that reduce waste and scrap generation and raw material usage concurrently reduce processing steps and operating costs. However, installing new technology requires capital construction and in nuclear facilities may require substantial additional cost to decontaminate and remove old equipment. These construction and decontamination operations also generate waste. Nevertheless, it is foreseeable that the future Complex could include some of these emerging technologies. This section discusses the major emerging technologies under consideration and their potential to further reduce future environmental impacts.

In the design of the Complex, there is a common waste management approach that emphasizes four areas of concern: the reduction of environmental impacts by avoiding environmentally offensive substances; process improvements that minimize waste generation; recycling, in order to minimize waste and raw material use; and the treatment of generated wastes. For some of the major processes, the following sections identify the significant benefits from emerging technologies that could reduce plant effluent, emissions, wastes, worker exposures, and operating cost.

3.5.1 Plutonium Fabrication and Processing

The plutonium facility includes a fabrication area where the plutonium is shaped into usable geometric shapes called pits and a processing area where the supporting chemical operations are performed. Plutonium from dismantled weapons may also be recovered. An amount of plutonium sufficient for carrying out fabrication and processing operations would be stored at the facility. The facility would be supported by activities such as analytical laboratories and waste management operations.

The emerging technologies for plutonium fabrication and processing are directed at minimizing waste at the source, reducing the amount of emissions, reducing the exposure of personnel to radiation, reducing the operational cost of the facility, improving recovery efficiencies, and improving safety. The following specific emerging technologies could affect the characteristics of the Plutonium Fabrication and Processing Facility and further reduce its environmental impact on the public and the safety and health of its workers.

For fabrication of plutonium parts, a near-net shape casting process is part of the baseline design. The casting undergoes additional machining, cleaning, and certification steps. This fabrication process is vastly superior to fabrication processes used in the past because the amount of scrap, waste, residue, and worker radiation dose are greatly reduced. Near-net shape casting technology development is continuing toward a goal of producing precision castings that require no additional machining and associated handling and material recycling. Even if the final goal is not met, any additional progress toward the goal allows for reduced machining, which results in reduced scrap, waste, residue, and worker radiation exposure.

An important fabrication step is a density measurement of the plutonium part. The baseline design

measurement process requires that the part be immersed in a brominated hydrocarbon fluid. Hazardous residue is left in the fluid and from the cleaning step that follows. An emerging technology would use a nonreactive gas as the density measurement medium. If this technology is able to provide the required precision, then no residue would be left from the measurement and no follow-up cleaning step would be required.

3.5.2 Uranium Fabrication and Processing

The production of nuclear weapons requires parts fabrication and supporting chemical operations for enriched uranium, depleted uranium, and depleted uranium alloys. Uranium from dismantled weapons may also be processed. An amount of uranium in its various forms would be stored at the facility sufficient for carrying out uranium fabrication and processing operations. The facility would be supported by activities such as analytical laboratories and waste management operations.

The emerging technologies for uranium fabrication and processing are directed at minimizing waste at the source, reducing the amount of emissions, reducing the operational cost of the facility, improving recovery efficiencies, improving safety, and reducing the exposure of personnel to radiation. Radiation exposure is not as big an issue for uranium operations as for plutonium operations, but there will always be an operational goal to reduce exposures consistent with an as-low-as-reasonably-achievable philosophy. The following specific emerging technologies could affect the characteristics of the Uranium Fabrication and Processing Facility and further reduce its environmental impact on the public and the impact to the safety and health of its workers.

The baseline technology for enriched uranium parts fabrication largely continues to rely on the same technologies that have been in use for many years. Some enriched uranium parts are produced by a wrought process that includes casting, rolling, forming, and machining. This process produces a substantial amount of scrap that must be recycled. Other parts are produced directly from a casting to a near-net shape, but these require a substantial amount of final machining. Advances in technology should improve the near-net shape casting process so that final machining is greatly reduced. The improved near-net shape casting process has fewer steps and generates far less scrap that must be recycled. The full implementation of this process would reduce cost, worker radiation exposure, and waste and residue production.

Baseline technology for depleted uranium and uranium alloy parts involves casting, rolling, forming, and machining operations in which the finished part is much smaller than the starting material. An emerging technology is spin forming of some or all of these parts. Although conceptually simple, it is very difficult to spin form to the proper specifications because of the metallurgical properties of uranium. After spin forming, a machining step would still be required, but the final part would have a substantial portion of the metal contained in the starting blank. Spin forming has far fewer process steps than the current process and generates far less scrap that must be processed. The full implementation of this process would reduce cost, worker radiation exposure, and waste and residue.

All uranium and uranium alloy products, whether using the baseline technology or emerging technologies, require a casting step. Currently, the crucibles and molds for casting are made of graphite. In some cases, the graphite is coated with rare earth oxides to extend its life and to reduce carbon contamination of the parts. Graphite molds and crucibles are expensive, have a short life even when coated, and become contaminated with uranium. There is ongoing development to improve coatings, to extend the life of molds and crucibles, and to reduce carbon contamination of parts and uranium contamination of the molds and crucibles. There is also development in alternative materials

for molds and crucibles. If improved coating or metal molds and crucibles prove to be feasible, their use in a production environment could reduce cost, and reduce or eliminate substantial quantities of contaminated graphite that must be processed.

Advanced uranium chemical processing technologies are currently under development. These technologies allow high-efficiency recovery and waste and residue processing with reduced worker and environmental radiation exposure. The chemicals used for processing, and the resulting emissions and effluents, are largely benign. These emerging processing technologies have been successfully tested in the laboratory, but have not been scaled up to the pilot plant level. This technology, if successful, could result in reductions in plant emissions and effluents as well as improvements in worker and public health and safety.

3.5.3 Lithium Hydride Fabrication and Processing

The basic steps of producing lithium hydride parts are hydriding lithium metal, grinding hydrided lithium into powder, pressing the powder into blanks, and machining the blanks into the final part. Near-net shape pressing technology has the potential to produce blanks that require less machining and therefore generate less material that must be recycled or stored. This process, if successful, could reduce the cost of operations. Environmental and waste impacts from current operations are very small.

Scrap and parts from old weapons are converted to a hydroxide, then to lithium chloride. The lithium chloride is converted to lithium metal in an electrolytic cell. This process poses hazards for workers and is an environmental emission hazard. The next step is to hydride the metal so it can serve as the feed material for the fabrication process. An emerging technology proven on a laboratory scale uses a bi-polar electrolytic cell to convert lithium hydroxide directly to lithium metal. This avoids the lithium chloride step and its associated emission and worker safety hazards.

3.5.4 High Explosives

The HE processes formulate, press, machine, and inspect main charges required for nuclear weapons and related research, development, and testing programs. Also included are explosive material recycling and disposition of explosives from disassembled weapons. Currently, excess explosive materials are disposed of by open burning or detonation. Alternative disposal technologies are being reviewed or developed for possible application. These alternative technologies include biodegradation, base hydrolysis, and reaction in a molten salt solution. Each of these technologies, if proved feasible, would be capable of reducing explosive materials to environmentally benign gases and chemicals.

3.6 Next Generation Stockpile Management Facilities

Stockpile management facilities have been sized in this analysis based on the planned and expected workload to support a START II-sized nuclear weapons stockpile. In addition, stockpile sizes larger and smaller than the START II protocol stockpile have been analyzed to assess the sensitivity of the analysis and the ultimate decision to pursue alternative stockpile sizes.

For all parts of nuclear weapons, except the plutonium pits, an existing large manufacturing capacity exists. Alternatives are considered for downsizing this large capacity at the manufacturing site or

transferring the mission to a laboratory or test site where a smaller development and test capability could be expanded to accommodate the production mission. The pit manufacturing capability and capacity was located at the DOE Rocky Flats Plant, which is no longer available for this mission. Therefore, only alternatives that build on an R&D plutonium infrastructure or, in the case of SRS, build on a plutonium infrastructure established for a different purpose, are considered in this analysis.

In sizing pit fabrication for the foreseeable future, consideration was given to establishing a larger fabrication capacity in line with the capacity planned for other portions of the Complex. However, after review of historical pit surveillance data, larger capacity was rejected because of the expected small demand for the fabrication of new replacement pits for the foreseeable future covered in this PEIS.

Construction and operation of a larger pit production capacity at this time would be expensive and would not have sufficient workload requirements for the foreseeable future to justify its maintenance and operation. DOE believes that significant advances are possible in facility design, construction, and operation which would significantly affect new plutonium facility size, cost, and environmental impact. DOE further believes that development and demonstration work should be performed on alternative facility concepts prior to making large financial and programmatic commitments, particularly in light of the expected small near-term requirement for pit production. DOE will perform development and demonstration work at its operating plutonium facilities over the next 5 years to study alternative modular facility concepts that could be utilized in the future in the construction of a larger fabrication capacity. Should a larger pit production capacity be required in the future, appropriate environmental and siting analyses would be performed at that time.

3.7 Comparison of Alternatives

To aid the reader in understanding the differences in environmental impacts among the various PEIS alternatives, this section presents comparisons of the alternatives, concentrating on the major resources assessed in this PEIS. In section 3.7.1, alternatives for each stockpile management mission (e.g., A/D, pit fabrication, secondary and case fabrication, nonnuclear fabrication, and HE fabrication) are compared with one another and the No Action alternative. Tables 3.7.1-1 through 3.7.1-4 contain the quantitative data to support these comparisons. Section 3.7.1 also contains a top-level comparison of the entire stockpile management program. That comparison assesses the major differences in environmental impacts between a Complex that is downsized/rightsized in-place (the preferred alternative) and a Complex that is consolidated to the maximum extent practicable.

In section 3.7.2, the three proposed stockpile stewardship facilities are compared with the No Action alternative. The quantitative data to support the comparisons for the proposed stockpile stewardship facilities are in the project-specific analyses found in appendixes I, J, and K.

3.7.1 Stockpile Management

To aid the reader in understanding the differences in environmental impacts among the various PEIS alternatives, this section presents comparisons of the alternatives, concentrating on the major resources assessed in this PEIS.

Assembly/Disassembly. In addition to the No Action alternative, two alternatives are being considered that would meet the needs of the Program: (1) downsizing the existing A/D facilities at Pantex and (2) transferring the A/D mission to NTS by expanding the Device Assembly Facility.

Under No Action, the A/D mission would remain at Pantex. No downsizing or modification of facilities would occur, and there would be no construction impacts. Downsizing existing facilities at Pantex would involve internal modifications to the existing facility. Transferring the A/D mission to NTS would entail upgrading and expanding the Device Assembly Facility.

Socioeconomic Impacts. Because of the reduced workload associated with completing the weapon dismantlement backlog, significant employment reductions will occur at Pantex for all alternatives. There would be a decrease from the current total of 3,437 workers to about 1,644 workers. Of the current workforce, 3,002 are associated with A/D operations. Under No Action only 915 A/D workers would be required. The downsized Pantex facility would be optimally configured for the reduced future workload, and would operate more efficiently than the No Action Pantex facility. The downsized Pantex facility would require 800 workers for single-shift operation. To perform operations in the downsized Pantex facility in a three-shift mode, 1,266 workers would be required.

If the A/D mission were transferred to NTS, 1,093 direct jobs (based on three-shift operation) would be created at that site, along with 1,160 indirect jobs. The 2,253 total new jobs would cause the regional economic area unemployment rate to decrease by approximately 0.1 percent. Housing/rental vacancies and public finance expenditures/revenues would change by less than 1 percent. If the A/D mission were transferred to NTS, there would be socioeconomic impacts associated with phasing out the A/D mission at Pantex. The phaseout would result in 1,644 direct jobs lost at the Pantex site, and another 1,905 indirect jobs would be lost in the regional economic area. The loss of 3,549 total jobs would cause the regional economic area unemployment rate to increase from 4.8 to 6.2 percent. Housing/rental vacancies and public finance expenditures/revenues would change by less than 1 percent.

Socioeconomic impacts at NTS associated with a peak construction workforce of 662 would produce small positive economic benefits. The 662 direct workers would also generate 622 indirect jobs. The 1,284 total new jobs during peak construction would cause no change in the regional economic area unemployment rate. Housing rental vacancies and public finance expenditures/revenues would change by less than 1 percent.

Resource Impacts. Due to the reduced workload expected in the future at Pantex, impacts from operations are expected to be less than current impacts. Air quality would remain within regulatory limits, and water requirements would be met without increased aquifer drawdowns. In addition, downsizing existing facilities at Pantex would involve internal modifications to the existing facility. No land would be disturbed.

Transferring the A/D mission to NTS would entail upgrading and expanding the Device Assembly Facility, with associated increases in land disturbance. An estimated 7.5 ha (18.5 acres) of additional land would be disturbed, which is less than 1 percent of the land available at NTS for development. This land disturbance would increase the potential to impact cultural and biotic resources; however, the impact to cultural resources is not expected to be significant because the proposed A/D site has been previously disturbed during construction activities associated with the Device Assembly Facility. Impacts to biotic resources are expected to be minor; however, the presence of the desert tortoise at NTS would require a site survey to determine any impacts. With mitigation measures already in place at NTS to minimize impacts to the Federal-listed desert tortoise, significant impacts due to the proposed project are not expected.

Because both alternatives would utilize similar facilities, procedures, resources, and numbers of

workers during operation, both alternatives would produce similar operational environmental impacts for most resource areas. Impacts to air quality were modeled, and results indicate minimal impacts for both alternatives. Water use for the NTS alternative is projected to be less than for the Pantex alternative because continued operations at Pantex would rely on existing, older, site-wide infrastructure. At both sites, water requirements could be adequately met without substantial aquifer drawdown. At Pantex, downsizing would reduce groundwater withdrawals by 21 percent compared to No Action. At NTS, water requirements to support the A/D mission would be approximately 4 percent more than projected usage. Groundwater withdrawals at NTS would be less than the recharge rates for the aquifer.

Radiation and Waste Management Impacts. The average radiological dose to workers at Pantex would not be expected to change, although the total worker dose would change due to the reduced number of workers associated with a reduction in workload. Worker exposure to radiation is expected to be about equal (approximately 10 mrem/year) for both alternatives and well within regulatory limits. Because of the small difference in the workforce for this mission at the two sites, this would result in a total worker dose of 3.0 person-rem/year at Pantex and 2.6 person-rem/year at NTS. The added risk to the workforce due to these levels of radiation exposure is extremely small.

Radiation exposure to the public from normal operation would be well within regulatory limits at both sites. At Pantex, the incremental dose to the population within 80 km (50 mi) would be 4.0x10-4 person-rem/year. At NTS, the incremental dose to the public within 80 km (50 mi) resulting from operation of the A/D Facility would be 3.1x10-6 person-rem/year. The added risk to the public due to these levels of radiation exposure is extremely small.

Both sites have adequate waste management facilities to treat, store, and/or dispose of wastes from the A/D mission, although LLW at Pantex would continue to be shipped offsite to NTS. The impacts of transporting LLW are similar to the impacts of transporting nonradiological materials, which are small. Transferring the A/D mission to NTS would eliminate the need to ship LLW from Pantex to NTS. Transferring the A/D mission to NTS by expanding the Device Assembly Facility would also increase the overall amount of eventual D&D activities and wastes.

Accident Impacts. Potential impacts from accidents would not be expected to change significantly due to reduced workload. Accident impacts were determined using computer modeling. For the composite accident, less than one fatal cancer would be expected for the surrounding 80-km (50-mi) population at either Pantex or NTS. Based on a weighted averaging of the postulated accidents, at Pantex there would be a statistical risk that one fatal cancer to a member of the public would result approximately every 43,000 years from accidents. At NTS, there would be a statistical risk that one fatal cancer to a member of the public would result approximately every 500,000 years from accidents.

Other. The A/D mission also includes an option to store strategic reserves of plutonium and/or uranium. At Pantex, which presently stores both strategic reserves and surplus quantities of plutonium, no additional facilities would be needed, and no significant new environmental impacts or risks would result. Storing the strategic reserve would not produce any additional air emissions, require any additional water withdrawals, generate any wastes, or require additional workers. At NTS, however, the Device Assembly Facility would be further expanded to accomplish the strategic reserve storage. The additional construction would have smaller impacts (less than 10 percent) than the construction associated with the Device Assembly Facility upgrade for the A/D mission. Radiation exposure to the public in the event of an accident would be significantly less than for the A/D mission for either alternative.

Pit Fabrication. For pit fabrication, a capability that no longer exists due to the closure of the Rocky Flats Plant, two alternatives are being considered that would reestablish this mission and meet the needs of the Program: (1) upgrading the existing plutonium R&D fabrication capability at LANL and (2) upgrading existing H-Area and F-Canyon facilities at SRS. Both alternatives involve relatively minor (though costly) upgrades to existing facilities. Under the No Action alternative, DOE would not reestablish this mission, but would rely on the existing R&D capabilities at LANL and LLNL.

Socioeconomic Impacts. During operation, both alternatives would have small positive socioeconomic impacts. Based on the socioeconomic modeling, impacts would be higher at SRS because of the indirect jobs that would be created due to this mission. Modeling results indicate no indirect jobs for this mission at LANL. At SRS, up to 813 direct jobs would be created for surge operations, along with 1,594 indirect jobs. These 2,407 total new jobs would cause the regional economic area unemployment rate to decrease from 6.7 to 6.0 percent. Housing/rental vacancies and public finance expenditures/revenues would change by less than 1 percent. At LANL, up to 260 new direct jobs would be created for surge operations, but no indirect jobs would be created. The 260 total new jobs would cause the regional economic area unemployment rate to decrease from 6.2 to 6.0 percent. Housing/rental vacancies and public finance expenditures/revenues would change by less than 1 percent. Because the SRS alternative has less of an infrastructure in place for plutonium fabrication, the SRS alternative would require more direct workers (288 versus 138) during construction. At both sites, however, the socioeconomic impacts during construction would not cause any socioeconomic indicator to change by more than 1 percent.

Resource Impacts. Construction activities would involve internal modifications to existing facilities, no land would be disturbed, and thus, no impacts to cultural and biotic resources would result. Because both alternatives would utilize similar facilities, procedures, resources, and numbers of workers during operation, both alternatives would result in similar operational environmental impacts for most resource areas. Impacts to air quality were modeled, and results indicate minimal impacts to air quality for both alternatives. Water requirements at SRS would be provided from surface water, which is plentiful, and no adverse impacts would be expected. At LANL, groundwater would be used. Water requirements for this mission, which would be less than 1 percent of projected No Action uses, could be adequately met without exceeding the groundwater allotment at LANL.

Radiation and Waste Management Impacts. Worker exposure to radiation is expected to be about equal for both alternatives and well within regulatory limits. At either SRS or LANL, the average workforce dose from this mission would be approximately 380 mrem/year. Because of a difference in workforce for this mission at the two sites, this would result in a total worker dose of 156 person-rem/year at SRS and 55 person-rem/year at LANL. Statistically, this would equate to one fatal cancer every 16 years at SRS, and every 45 years at LANL, from operation of the Pit Fabrication Facility. Radiation exposure to the public from normal operation would be well within regulatory limits at both sites. At SRS and LANL, the incremental dose to the public within 80 km (50 mi) would be 5.9x10-4 person-rem/year and 8.6x10-5 person-rem/year, respectively. The added risk to the public due to these levels of radiation exposure is extremely small. Both site alternatives have adequate existing waste management facilities to treat, store, and/or dispose of wastes that would be generated by this mission.

Accident Impacts. Potential impacts from accidents were determined using computer modeling. For the composite accident, less than one fatal cancer would be expected for the surrounding 80-km (50-mi) population at both SRS and LANL. Based on a weighted averaging of the postulated accidents, at

SRS there would be a statistical risk that one fatal cancer to a member of the public would result approximately every 360,000 years from accidents. At LANL, there would be a statistical risk that one fatal cancer to a member of the public would result approximately every 160,000 years from accidents.

Secondary and Case Fabrication. In addition to the No Action alternative, three alternatives being considered would meet the needs of the Program: (1) downsizing facilities that presently perform this mission at ORR, (2) transferring the secondary and case fabrication mission to LANL by upgrading the existing R&D secondary and case fabrication capabilities of LANL, and (3) transferring the secondary and case fabrication mission to LLNL by upgrading the existing R&D secondary and case fabrication capabilities of LLNL. Under No Action, the secondary and case fabrication mission would remain at Y-12 at ORR, and no downsizing or modification of facilities would occur.

Socioeconomic Impacts. Under No Action, there would be a decrease in the number of workers at Y-12 from the current total of 5,152 workers to 4,721 workers. Of the 5,152 workers, 3,126 are currently associated with the core stockpile management mission. Under No Action, only 2,741 core stockpile management workers would be required. The downsized Y-12 would be optimally configured for the reduced future workload, operate more efficiently, and require 784 workers for single-shift operation, a reduction of 1,957 workers. To perform operations in the downsized Y-12 in a three-shift mode, 1,376 core stockpile management workers would be required, a reduction of 1,365 workers. A reduction of 1,365 direct jobs represents approximately 9 percent of the projected No Action workforce at the entire ORR site, and less than 1 percent of the regional economic area. Another 3,490 indirect jobs would also be lost.

Mitigating the workforce reductions would be the fact that downsizing would require 1,152 new jobs associated with landlord activities in preparation for D&D activities. Another 1,600 indirect jobs would be created by these D&D jobs. The net effect for the three-shift mode of operation would be a loss of a total of 213 direct jobs at Y-12, which would represent less than 1 percent of the projected No Action workforce at ORR.

Transferring the secondary and case fabrication mission to either LANL or LLNL would have small positive socioeconomic impacts at those sites, and negative socioeconomic impacts at ORR due to the phaseout of this mission. At LANL, 321 direct jobs (based on three-shift operation) would be created, but no indirect jobs would be created for this industry. The 321 new jobs would cause the regional economic area unemployment rate to decrease from 6.2 to 6.0 percent. Housing/rental vacancies and public finance expenditures/revenues would change by less than 1 percent. At LLNL, 290 new direct jobs (based on three-shift operation) would be created, along with 722 indirect jobs. The 1,012 new jobs would cause the regional economic area unemployment rate to decrease by less than 1 percent. Housing/rental vacancies and public finance expenditures/revenues would change by less than 1 percent.

Transferring the secondary and case fabrication mission from ORR to either LANL or LLNL would result in the loss of 3,336 direct jobs projected for this mission under No Action at Y-12, and the closure and D&D of the Y-12 facilities previously involved in this mission. Another 10,134 indirect jobs could also be lost. It is expected that 1,385 new jobs would be created by a direct transfer of responsibilities from DP to EM. Additionally, because the D&D of facilities at ORR would be a relatively long-term process, any initial negative socioeconomic impacts resulting from the transfer of the secondary and case fabrication mission to LANL or LLNL would be minimized by the additional workforce associated with D&D activities at ORR. These 1,385 new D&D jobs would also create

1,937 new indirect jobs. The net effect would be a loss of a total of 13,470 total jobs (direct plus indirect) in the ORR regional economic area. This would cause the regional economic area unemployment rate to increase from 4.9 to 7.4 percent. Housing/rental vacancies and public finance expenditures/revenues would change by less than 1 percent.

During construction activities, socioeconomic impacts would result, but would be small. The number of peak workers would be 14 at ORR, 55 at LANL, and 130 at LLNL, which has the least extensive existing infrastructure for secondary and case fabrication. At all three sites, the socioeconomic impacts during construction would not cause any socioeconomic indicator to change by more than 1 percent.

Resource Impacts. Impacts from continued operation at Y-12 are expected to be similar to current impacts. Air quality would remain within regulatory limits and water requirements would be adequately met by surface water withdrawals. For the three "action" alternatives, no previously undisturbed land would be disturbed, and thus, no impacts to biotic resources would result. Minimal impacts to cultural resources may result from building modifications to facilities eligible for the National Register of Historic Places. Because each of the alternatives would utilize similar facilities, procedures, resources, and numbers of workers during operation, each of the alternatives would produce similar operational environmental impacts for most resource areas. Impacts to air quality were modeled for each alternative and results indicate minimal impacts to air quality for each of the alternatives. Water requirements at ORR would be met from surface water, which is plentiful, and no adverse impacts would be expected. At LANL, groundwater would be used. Groundwater withdrawals would increase by less than 1 percent over projected No Action water requirements, and LANL's groundwater allotment would not be exceeded. At LLNL, public water supply would be used, and usage would be approximately 20-percent higher than projected No Action water requirements. No adverse impacts to water resources are expected.

Radiation and Waste Management Impacts. Radiation worker exposure to radiation is expected to be about equal for all three alternatives and well within regulatory limits. At each of the three sites, the average workforce dose from this mission would be approximately 2.2 mrem/year. Because of differences in projected workforces, this would result in a total worker dose of 0.38 person-rem/year at ORR, 0.33 person-rem/year at LANL, and 0.55 person-rem/year at LLNL. The added risk to the workforce due to these levels of radiation exposure is extremely small. Radiation exposure to the public from normal operation would be well within regulatory limits at these sites. At ORR, the incremental dose to the population within 80 km (50 mi) would be 0.6 person rem/year. The probability of a member of the public dying from cancer would be 3x10-4/year. At LANL, the incremental dose to the population within 80 km (50 mi) would be 0.5 person-rem/year. The probability of a member of the public dying from cancer would be 2.5x10-4/year. At LLNL, the incremental dose to the population within 80 km (50 mi) would be 0.84 person-rem/year. The probability of a member of the public dying from cancer would be 4.2x10-4/year. The added risk to the public due to these levels of radiation exposure is extremely small. All three site alternatives have adequate existing waste management facilities to treat, store, and/or dispose of wastes that would be generated by this mission.

Accident Impacts. Potential impacts from accidents were determined using computer modeling. For all postulated accidents, less than one fatal cancer would be expected for the surrounding 80-km (50-mi) population at each of the sites. Based on a weighted averaging of the postulated accidents, at ORR and LANL there would be a statistical risk that one fatal cancer to a member of the public would result approximately every 830,000 years from accidents. At LLNL, there would be a

statistical risk that one fatal cancer to a member of the public would result approximately every 260,000 years from accidents.

Other. If the secondary and case fabrication mission were transferred from ORR, storage of the strategic reserves of HEU would be transferred to the A/D Facility (or a consolidated storage facility being assessed in the Storage and Disposition PEIS). The potential impacts associated with the one-time transfer of the strategic reserves of HEU to the A/D Facility are expected to be minor, even in the event of an accident, due to the robust shipping containers.

High Explosives Fabrication. In addition to the No Action alternative, three alternatives are being considered that would meet the needs of the Program: (1) downsizing facilities that presently perform this mission at Pantex, (2) transferring the HE fabrication mission to LANL by upgrading the existing R&D HE fabrication capabilities of LANL, and/or (3) transferring the HE fabrication mission to LLNL by upgrading the existing R&D HE fabrication capabilities of LLNL. Transferring the HE fabrication from Pantex to LANL and/or LLNL would result in the closure and D&D of Pantex facilities previously involved in this activity. Under No Action, the HE fabrication mission would remain at Pantex. No downsizing or modification of facilities would occur.

Socioeconomic Impacts. Downsizing the HE fabrication mission at Pantex would reduce the number of direct workers associated with this mission to 37, compared to 105 for No Action. Transferring the HE fabrication mission to either LANL or LLNL would create small positive socioeconomic impacts at either of those sites, and small negative socioeconomic impacts at Pantex, due to the phaseout of this mission. For surge operations at LANL, 67 new direct jobs would be created, but no indirect jobs would be created by this industry. The 67 new jobs would cause the regional economic area unemployment rate to decrease from 6.2 to 6.1 percent. Housing/rental vacancies and public finance expenditures/revenues would change by less than 1 percent. For surge operations at LLNL, 100 new direct jobs would be created, along with 155 indirect jobs. The 255 total new jobs would cause the regional economic area unemployment rate to decrease by less than 1 percent. Housing/rental vacancies and public finance expenditures/revenues would change by less than 1 percent. Phasing out the HE fabrication mission at Pantex would cause the loss of 105 direct jobs, which would be approximately 3 percent of the projected No Action workforce at Pantex. The direct plus indirect jobs lost would cause no observable change to the Pantex regional economic area unemployment rate, housing/rental vacancies, and public finance expenditures/revenues.

During construction activities, socioeconomic impacts would result, but they would be small. The number of peak workers would be 29 at Pantex, 46 at LANL, and 19 at LLNL. At all three sites, the socioeconomic impacts during construction would not cause any socioeconomic indicator to change by more than 1 percent.

Resource Impacts. For the three "action" alternatives, construction impacts are expected to be minor and would involve internal modifications to existing facilities. No land would be disturbed at Pantex or LANL, and thus, no impacts to cultural or biotic resources would result. At LLNL, a small area of land (less than 1 ha) would be disturbed to construct an HE and parts storage building, but impacts to biotic and cultural resources are not expected.

Because each of the alternatives would utilize similar facilities, procedures, resources, and numbers of workers during operation, each of the alternatives would result in similar operational environmental impacts for most resource areas. Impacts to air quality were modeled for each alternative, and results indicate minimal impacts to air quality for each of the alternatives. At all sites,

water requirements would be met from groundwater. At Pantex, this alternative applies only in conjunction with the downsize A/D alternative at Pantex discussed earlier. Downsizing both missions would reduce groundwater withdrawals by 16 percent compared to No Action. At LANL, groundwater withdrawals would increase by less than 1 percent over projected No Action water requirements, and LANL's groundwater allotment would not be exceeded. At LLNL, groundwater and/or the public water supply could be used to support the HE fabrication mission. If public water were used, it would require approximately 21 percent of the design capacity of the public water tap line. If groundwater were used, withdrawals would increase by approximately 65 percent from No Action, but they would not have any adverse impacts to aquifer levels.

Radiation and Waste Management Impacts. There are no radiological risks to workers or the public associated with the HE fabrication mission and no adverse impacts associated with normal operation. All three site alternatives have adequate existing waste management facilities to treat, store, and/or dispose of wastes that would be generated by this mission.

Accident Impacts. Potential impacts from chemical accidents or explosions were determined using modeling. Impacts from these types of accidents could include death or bodily damage. Due to proximity, workers would be most susceptible to any potential impacts. For all postulated accidents, impacts to the public were much less than to workers. In the event of an accident involving HE fabrication, due to the higher population surrounding LLNL, public impacts could be higher at LLNL compared to LANL and Pantex. Lastly, transferring the HE fabrication mission from Pantex to LANL and/or LLNL would require HE components to be shipped from the fabrication site to the A/D Facility. HE is a nonradioactive, hazardous material. There are no impacts associated with the incident-free transportation of HE. In the event of an accident, HE transportation impacts would be no greater than those encountered by the public from industry's transportation of similar explosives. Potential accidents could include both explosive and nonexplosive roadway accidents, with potential impacts of death, lesser bodily injury, and property damage.

Nonnuclear Fabrication. In addition to the No Action alternative, two alternatives are being considered that would meet the needs of the Program: (1) downsizing the facilities that presently perform this mission at KCP and (2) transferring the KCP nonnuclear fabrication mission to LANL, LLNL, and SNL by upgrading existing nonnuclear fabrication capabilities at LANL and LLNL and constructing new nonnuclear fabrication facilities at SNL. Under No Action, the nonnuclear fabrication mission would remain at current locations; primarily at KCP, with small workloads at SNL and LANL.

Socioeconomic Impacts. At KCP, workforce downsizing consistent with a reduced workload has already taken place; therefore, the projected No Action workforce (3,179 workers) is equal to the current workforce. Of these 3,179 workers, 2,508 workers perform core stockpile management missions. The downsized KCP facility would be optimally configured for the reduced future workload, would operate more efficiently, and would require 1,669 core stockpile management workers for single-shift operation. To perform operations in the downsized KCP facility in a three-shift mode, 2,257 workers would be required. This is 251 workers less than the No Action single-shift number of workers. Another 443 indirect jobs would also be lost. The loss of a total of 694 jobs (direct plus indirect jobs) would not cause the regional economic area unemployment rate to change.

Transferring the nonnuclear fabrication mission to the laboratories would create small positive socioeconomic impacts at both LANL and LLNL, with increases of 240 and 131 total (direct plus indirect) jobs, respectively. At each of these sites, socioeconomic indicators would change by less

than 1 percent. At SNL, 1,160 direct jobs would be created, along with 1,350 indirect jobs. The 2,510 new jobs would cause the regional economic area unemployment rate to decrease from 5.7 to 5.2 percent. Housing/rental vacancies and public finance expenditures/revenues would change by less than 1 percent. Phasing out the nonnuclear fabrication mission from KCP would cause the loss of 3,179 direct jobs and the loss of 5,609 indirect jobs in the regional economic area. The loss of 8,788 total jobs from KCP would cause the regional economic area unemployment rate to increase from 4.9 to 5.6 percent. Housing/rental vacancies and public finance expenditures/revenues would change by less than 1 percent. Some socioeconomic impacts could be mitigated by employing personnel for D&D of the KCP facility, although that is not expected to last more than 5 years.

During construction activities, socioeconomic impacts would result, but would be small. At KCP, 187 direct jobs would be created during downsizing activities, plus another 262 indirect jobs. The 449 total jobs created during construction at KCP would represent less than a 1 percent increase in the regional economic area, and would cause no observable change to the regional economic area unemployment rate, housing/rental vacancies, and public finance expenditures/revenues. If the nonnuclear fabrication mission is transferred to the three laboratories, no observable socioeconomic impacts would occur at LANL or LLNL. At SNL, 379 direct jobs would be created during construction activities, plus another 421 indirect jobs. The 800 total jobs created during construction at SNL would represent less than a 1 percent increase in employment in the regional economic area, and would not cause any socioeconomic indicator to change by more than 1 percent.

Resource Impacts. Due to the reduced workload expected in the future, impacts from operations are expected to be less than current impacts. Air quality would remain within regulatory limits at each of the sites, and water requirements would be adequately met.

For the alternative that would downsize KCP, the construction activities would involve internal modifications to the existing facility. No land would be disturbed. For the alternative that would transfer the KCP mission to the laboratories, construction impacts would involve internal facility modifications at LANL and LLNL. At SNL, approximately 9 ha (22 acres) of land would be disturbed to construct a new facility. This represents approximately 6 percent of the undisturbed land at SNL. Potential impacts to cultural and biotic resources would exist, but they would be mitigated to the extent practicable during follow-on, site-specific studies.

Because each of the alternatives would utilize similar facilities, procedures, resources, and numbers of workers during operation, each of the alternatives would result in similar operational environmental impacts for most resource areas. Impacts to air quality were modeled for each alternative. Modeling results indicate minimal impacts to air quality for each of the alternatives. Water requirements for nonnuclear fabrication are relatively minor at each of the sites. At KCP, water requirements, which are publicly provided, would be reduced by approximately 31 percent compared to No Action. At LANL, groundwater withdrawals would increase by less than 1 percent over projected No Action water requirements, and LANL's groundwater allotment would not be exceeded. At LLNL, there would also be a less than 1 percent increase in water requirements to support nonnuclear fabrication. At SNL, groundwater would be used. Groundwater withdrawals would increase by approximately 64 percent over projected No Action withdrawals, but would still represent only 29 percent of the Kirtland Air Force Base groundwater rights. Thus, no adverse impacts are expected.

Radiation, Waste Management, and Accident Impacts. There are no radiological risks to workers or the public associated with the nonnuclear fabrication mission, and there are no adverse impacts

associated with normal operation. Accident profiles at the sites would not change as a result of downsizing KCP or transferring the nonnuclear fabrication mission to the laboratories. Phaseout of the nonnuclear mission from KCP would eliminate any potential accidents at that site. Lastly, all three site alternatives have adequate existing waste management facilities to treat, store, and/or dispose of wastes that would be generated by this mission.

Stockpile Management Top-Level Comparison. Based upon the reasonable alternatives for the five major missions that make up the stockpile management program, one could construct a matrix with a large number of discrete alternatives for the entire Complex. Analyzing such a large number of alternatives is neither practical nor useful. What is useful, however, is to look at the two extreme configurations for the entire Complex in order to compare environmental impacts for a bounding case analysis. Based on the alternatives that are reasonable for the individual missions, the bounding configurations and environmental impacts for the Complex are a relatively unconsolidated Complex that is downsized/rightsized in place or a relatively consolidated Complex that is rightsized by upsizing the laboratories and NTS.

For the first configuration (referred to as Downsize/Rightsize-in-Place), the Complex would consist of A/D at Pantex, HE fabrication at Pantex, pit fabrication at LANL (or SRS), secondary and case fabrication at ORR, and nonnuclear fabrication at KCP. This is essentially the preferred alternative for stockpile management. For the second configuration (referred to as Maximum Consolidation), the Complex would consist of A/D at NTS, HE fabrication at LANL (or LLNL), pit fabrication at LANL, secondary and case fabrication at LANL (or LLNL), and nonnuclear fabrication at SNL, LANL, and LLNL. Major differences in environmental impacts between these two configurations are presented below.

Socioeconomic Impacts. It is worthy to note that some of the reductions in workforce at the various stockpile management facilities are associated with reduced workloads expected in the future, while additional reductions in workforce could occur due to the physical downsizing of facilities. For the A/D and HE missions at Pantex, under No Action, the core stockpile management workforce would be reduced from the current level of 3,107 workers (3,002 for A/D and 105 for HE) to 1,020 workers (915 for A/D and 105 for HE) for single-shift operation. The physical downsizing of the facility would also improve efficiency such that the workforce could be reduced even further, to 831 workers for single-shift operation (800 for A/D and 31 for HE). Three-shift operation of the downsized Pantex facility would require 1,303 core stockpile management workers (1266 for A/D and 37 for HE).

For the secondary and case fabrication mission at ORR, under No Action, the workforce would be reduced from the current level of 3,126 core stockpile management workers to 2,741 workers for single-shift operation. The physical downsizing of Y-12 (essentially an 86-percent reduction in facility size) would also improve efficiency such that the core stockpile management workforce could be reduced even further, to 784 workers for single-shift operation. Three-shift operation of the downsized Y-12 facility would require 1,376 core stockpile management workers. The adverse socioeconomic impacts associated with the Y-12 downsizing would be mitigated by the creation of 1,152 new jobs associated with landlord activities in preparation for the D&D of the facilities no longer needed.

At KCP, workforce reductions consistent with a reduced workload have already taken place; therefore, the projected No Action workforce (2,508 core stockpile management workers) is equal to the current workforce. Downsizing the KCP facility would improve efficiency such that the workforce could be reduced to 1,669 workers for single-shift operation. Three-shift operation of the

downsized KCP facility would require 2,257 workers.

Overall, socioeconomic impacts from construction for the Maximum Consolidation configuration would be minimal, except at NTS and SNL. Socioeconomic impacts from construction for the Downsize/Rightsize-in-Place configuration would also be minimal.

Resource Impacts. Construction impacts associated with the Downsize/Rightsize-in-Place configuration would be minimal. All construction activities would be modifications to existing facilities, with no new construction. Consequently, no significant land disturbance at any sites would result, and no potential impacts to biota or cultural resources would occur.

Construction impacts associated with the Maximum Consolidation configuration would be small overall; only the Device Assembly Facility upgrade at NTS and the Nonnuclear Facility at SNL involve any land disturbance greater than 1 ha (2.47 acres). Most construction activities would be modifications to existing facilities, with no significant land disturbance, and no potential impacts to biota or cultural resources.

During operation, because each of the two configurations would utilize similar facilities, procedures, resources, and numbers of workers, each would result in similar operational environmental impacts for most resource areas. For the Maximum Consolidation configuration, the greatest potential for any significant environmental impacts would occur at LANL, which would be the site for pit fabrication, secondary and case fabrication, HE fabrication, and a portion of nonnuclear fabrication. For each of the resources evaluated in this PEIS, no significant impacts are expected from such consolidation. Modeling results for air quality indicate minimal impacts to air quality. Water requirements would increase at LANL by 2.5 percent, but would still be less than the LANL allotment.

Radiation, Waste Management, and Accident Impacts. Cumulative doses to the population from normal operation would be less than regulatory limits. Impacts from accidents are independent of other missions (e.g., accident risks are additive, not multiplicative). Thus, the potential accident would be the sum of the risks from each mission. For maximum consolidation at LANL, there would be a statistical risk that one fatal cancer to a member of the public would result aproximately every 135,000 years from accidents. LANL would have adequate existing waste management facilities to treat, store, and/or dispose of wastes that would be generated by these missions.

A difference in the operation of the Downsize/Rightsize-in-Place configuration and the Maximum Consolidation configuration would involve the transportation of nuclear and hazardous materials. The Downsize/Rightsize-in-Place configuration would result in transporting plutonium components between LANL (or SRS) and Pantex, and transporting secondary and case components between ORR and Pantex. Incident-free impacts associated with this transportation are small, while accident impacts are minor. The Maximum Consolidation configuration would also result in transporting plutonium components and secondary and case components. Transportation would occur between LANL and NTS. Relative to the Downsize/Rightsize-in-Place configuration, any transportation impacts would be less due to shorter distances and less populated roadways. The Maximum Consolidation configuration would also result in transporting HE components between LANL and NTS, but no significant impacts are expected.

3.7.2 Stockpile Stewardship

Proposed National Ignition Facility. The following comparisons have been summarized from the

more-detailed comparisons for the NIF alternatives found in appendix section I.3.5.

The NIF project-specific analysis addresses the impacts of constructing and operating NIF at four alternative sites: LLNL (preferred), LANL, SNL, and NTS (including NLVF). A No Action alternative is also assessed.

Under No Action, DOE would rely on existing aboveground experimental facilities, predominantly the Nova Facility at LLNL, to study the physics of nuclear weapons secondaries. No construction impacts are associated with the No Action alternative and the operational impacts of the Nova Facility have been accounted for in the overall environmental baseline presented for LLNL.

For the action alternative, the analysis indicates that there would be few significant differences in environmental impacts at the candidate sites. The maximum 24-hour concentration of particulate matter 10 microns or smaller (PM_{10}) in the air during site clearing would exceed applicable standards at LLNL and NLVF. However, the ambient air quality impacts would be localized and of short duration. Uncommitted land requirements would be greatest at NTS (18.2odyText"> At each NIF alternative site, beneficial socioeconomic impacts associated with construction and operation would occur. During construction, 270 to 470 direct new jobs would be created in the peak year of activity. These direct jobs would create indirect jobs such that the total jobs during the peak year would be: 2,870 at LLNL; 1,130 at LANL; 1,640 at NTS; and 1,770 at SNL. Once operations begin, NIF would employ 330 direct workers. The total number of jobs (direct plus indirect) during operation would be 890 at LLNL, 600 at LANL, 620 at NTS, and 670 at SNL.

Over the 30-year operational life of NIF, the public would be exposed to a very small dose of radiation. No cancer fatalities would be expected to occur from exposures associated with routine NIF operations under either the Conceptual Design or Enhanced options. A radiological accident at NIF would not cause any cancer fatalities to the public except possibly at NLVF and SNL. Under postulated accident conditions, radiological impacts to the public and workers would be minor. The highest calculated radiation dose is 4,900 person-rem. At most, two cancer fatalities could occur if an accidental release occurred. Because of the extremely low accidental release frequency ($2x10^{-8}$ /yr), the risk of radiation-caused cancer fatalities from the postulated accident at any site is essentially zero. The cancer fatality risk associated with radiological exposure from an accident involving the transport of NIF tritium targets would range from 1x10-*8* to 8x10-*10/yr*; whereas the nonradiological fatality risks associated with vehicular emissions and accidents would be in the range of 10-3 to 10-4/yr.

Although each candidate site would implement waste minimization practices, the generation of additional wastes would be unavoidable. All candidate sites have current or planned capacity to handle wastes associated with construction and operation of NIF; however, this would entail offsite shipment of some of the wastes for all sites but LANL.

NIF would comply with all applicable Federal, state, and local environmental regulatory requirements, including the *California Environmental Quality Act* if NIF is sited in the State of California. Such compliance functions as a general form of mitigation. The candidate sites have also established several mitigative measures for construction actions that would also be applicable to NIF construction. While each of these mitigative measures may be minor, in combination they could significantly reduce impacts to the environmental resources of the selected site.

With regard to unavoidable impacts, land clearing and construction activities for NIF would eliminate

habitat and destroy or displace wildlife. Construction of new facilities could result in short-term disturbances of previously undisturbed biological habitats. These disturbances could cause long-term reductions in the biological productivity of an area. Construction of NIF would replace natural habitat with areas of pavement and buildings. Depending upon the candidate site selected, this conversion could extend the influence of urbanized/industrial habitats into natural areas, increase fragmentation of natural habitat, and cause minor loss of habitat used by rare species. However, no critical habitat for federally threatened or endangered species would be affected. Radiological doses to the general public from NIF operation would be no more than 20e addition of the incremental effects of the construction and operation of NIF to the effects of other past, present, and reasonably foreseeable future actions at the selected site. Fugitive dust emissions from construction of NIF would be an incremental addition to the already existing environmental impact of dust emissions to the atmosphere. Minor changes in stormwater runoff are expected due to removal of grass cover during NIF construction and increased runoff from pavement during facility operation.

Proposed Contained Firing Facility. The following comparisons have been summarized from the more-detailed information for CFF found in appendix J.

Under No Action, DOE would rely on existing aboveground experimental facilities, predominantly the existing hydrotest facilities at LLNL, LANL, and NTS to study the physics of nuclear weapons primaries. No construction impacts are associated with those existing facilities, and the operational impacts of those facilities have been accounted for in the overall environmental baseline presented for LLNL, LANL, and NTS.

Because the proposal for CFF involves modification to the existing FXR Facility, construction impacts are expected to be small. Very little land would be disturbed and the construction activities would largely involve internal modifications to the existing facility. Wastes and socioeconomic impacts from construction would be negligible.

Impacts associated with operations would also be negligible. CFF would not utilize any significant quantities of resources, would not cause any significant socioeconomic changes at LLNL, and would not generate large quantities of hazardous or low-level wastes. LLNL has adequate existing waste management facilities to treat, store, and/or dispose of wastes that would be generated by CFF. Impacts to human health from CFF operations are expected to be extremely small and within regulatory limits.

Proposed Atlas Facility. The following comparisons have been summarized from the more-detailed information for the Atlas Facility found in appendix K.

Under No Action, DOE would rely on existing aboveground experimental facilities, predominantly the Pegasus Facility at TA-35 at LANL, to study the physics of nuclear weapon secondaries. No construction impacts are associated with that facility, and the operational impacts from Pegasus have been accounted for in the overall environmental baseline presented for LANL.

Because the proposal for the Atlas Facility involves modification to the existing facilities within TA-35, construction impacts are expected to be small. Very little land would be disturbed and the construction activities would largely involve internal modifications to the existing facility. Wastes and socioeconomic impacts from modification activities would be negligible.

Impacts associated with operations would also be negligible. The Atlas Facility would not utilize any

significant quantities of resources, would not cause any significant socioeconomic changes at LANL, and would not generate large quantities of hazardous or low-level wastes. LANL has adequate existing waste management facilities to treat, store, and/or dispose of wastes that would be generated by the Atlas Facility. Impacts to human health from Atlas Facility operations are expected to be small and within regulatory limits.

3.8 Preferred Alternative

CEQ regulations require an agency to identify its preferred alternative(s) in the Final Environmental Impact Statement (40 CFR 1502.14[e]). The preferred alternative is the alternative which the agency believes would best fulfill its statutory mission, considering environmental, economic, technical, and other factors. This PEIS provides information on the environmental impacts. Cost, schedule, and technical analyses have also been prepared, and are presented in the *Analysis of Stockpile Management Alternatives* report (DOE 1996j) and the *Stockpile Management Preferred Alternatives* Report (DOE 1996k), which are available in the appropriate DOE Public Reading Rooms for public review.

DOE has identified the following preferred alternatives for the Stockpile Stewardship and Management Program:

Stockpile Stewardship:

- Construct and operate NIF at LLNL
- Construct and operate CFF at LLNL
- Construct and operate the Atlas Facility at LANL

Stockpile Management:

- Secondary and Case Component Fabrication--downsize the Y-12 Plant at ORR
- Pit Component Fabrication--reestablish capability and appropriate capacity at LANL
- Assembly/Disassembly--downsize at Pantex
- High Explosives Fabrication--downsize at Pantex
- Nonnuclear Component Fabrication--downsize at KCP
- Based on the analyses performed to support this PEIS, the preferred alternatives for strategic reserve storage are as follows: (1) HEU strategic reserve storage at Y-12 and (2) plutonium pit strategic reserve storage in Zone 12 at Pantex. The preferred alternatives for strategic reserve storage could change based upon decisions to be made in regard to the Storage and Disposition PEIS. Decisions on strategic reserve storage will not be made in the upcoming ROD for the Stockpile Stewardship and Management Program. Storage decisions are not expected to be made until both the Stockpile Stewardship and Management PEIS and the Storage and Disposition PEIS are completed.

The preferred alternative for plutonium-242 oxide at SRS is to transport the material to LANL for storage.

The preferred PEIS alternatives do not represent decisions by DOE. Rather, they reflect DOE's preferences based on existing information. The ROD, when issued, will describe DOE's decisions for the Stockpile Stewardship and Management PEIS proposed actions.

Table 3.7.1-1.--*Summary Comparison of Impacts for Assembly/Disassembly and High Explosives Fabrication Missions*

	Retain both at Pantex		Retain A/D[1] at Pantex, Relocate HE			Phaseout Pantex, Relocate A/D and HE			
	No Action	Downsize A/D and HE at Pantex	Downsize A/D at Pantex and Relocate HE	Relocate HE to LANL[2]	Relocate HE to LLNL[2] (Site 300)	Phaseout A/D and HE at Pantex	Relocate A/D to NTS	Relocate HE to LANL[2]	Relocate HE to LLNL[2] (Site 300)
Construction/Modification									
Land									
Disturbed land (ha)	0	0	0	0	0.8	0	7.5	0	0.8
Percent of available land	0	0	0	0	<1	0	<1	0	<1
Threatened and Endangered Species									
Potentially affected	None	None	None	None	None	None	Desert tortoise	None	None
Socioeconomics									
Peak workers (direct)	0	96	67	46	19	0	662	46	19
Total jobs (direct and indirect)	0	173	121	76	47	0	1,284	76	47
Operation[3]									
Water									
Use (MLY)	249	209	196	5,773	148	0	2,498	5,773	148
Percent change from current use	-70	-75	-77	4.6	64.7	-100	4.1	4.6	64.7
Percent change from No Action use	NA	-16	-21	0.2	64.7	-100	4.1	0.2	64.7
Percent of groundwater allotment[4]	NA	NA	NA	85	NA	NA	NA	85	NA
Discharge (MLY)	141	148	141	706	12.2	0	53	706	12.2
Percent change from current discharge	-71	-69	-71	2	154	-100	NA	2	154
Percent change from No Action discharge	NA	5	0	2	177	-100	NA	2	177

Percent of discharge capacity	NA	NA	NA	NA	102	NA	NA	NA	102
Total site workforce (all missions)	1,644	1,927	1,890	6,613	8,289	0	9,112	6,613	8,289
A/D workforce	915	1,266[5]	1,266[5]	0	0	0	1,093	0	0
HE workforce	105	37[6]	0	200[7]	232[8]	0	0	200[6]	232[7]
A/D and HE workforce	1,020	1,303	1,266	200	232	0	1,093	200	232
Change from No Action in Total Jobs (direct and indirect)	NA	611 [9]	531 [10]	67	255	-3,549	2,253	67	255
Human Health									
Normal Operations									
Annual population dose (person-rem) (incremental except No Action)	1.4x10-4	4.0x10-4	4.0x10-4	NA	NA	-1.4x10-4	3.1x10-6	NA	NA
25-year fatal cancers (incremental except No Action)	1.8x10-6	5.0x10-6	5.0x10-6	NA	NA	-1.8x10-6	3.9x10-8	NA	NA
Annual worker dose (mrem/yr) (total)	10	10	10	NA	NA	0	10	NA	NA
25-year fatal cancer risk (total)	1.0x10-4	1.0x10-4	1.0x10-4	NA	NA	0	1.0x10-4	NA	NA
Accidents									
Composite Set (EBAs and BEBAs) [11]									
Expected consequences (fatalities)[12]		5.2x10-4	5.2x10-4	NA	NA	0	4.4x10-5	NA	NA
Expected Risk (fatalities per year)l		1.5x10-5	1.5x10-5	NA	NA	0	1.2x10-6	NA	NA

Waste Management	LLW, mixed LLW, hazardous, and nonhazardous wastes would continue to be generated.	Existing facilities adequate; 1 additional shipment every 2 years of LLW to NTS	Same as Downsize A/D & HE during operation. HE fabrication D&D would require 579 shipments of LLW to NTS during HE phaseout period. Additional treatment capacity at Pantex would be needed for liquid LLW and Mixed LLW generated from D&D activities.	Existing facilities adequate	Existing facilities adequate	Eliminates future shipments of Pantex LLW to NTS. D&D would require 1,006 shipments of LLW to NTS during phaseout period. Additional treatment capacity at Pantex would be needed for liquid LLW and Mixed LLW.	Existing facilities adequate	Existing facilities adequate	Existing facilities adequate

Table 3.7.1-2.-- ***Summary Comparison of Impacts for the Nonnuclear Fabrication Mission***

			Relocate Nonnuclear and Phaseout KCP[13]			
	No Action	**Downsize KCP**	**LANL**	**LLNL**	**SNL**	**Phaseout KCP**
Construction/Modification						
Land						
Disturbed land (ha)	0	0	0	0	9	0
Percent of available land	0	0	0	0	6	0
Threatened and Endangered Species						
Potentially affected	None	None	None	None	None	None
Socioeconomics						
Peak workers (direct)	0	187	6	6	379	0
Total jobs (direct and indirect)	0	449	10	15	800	0
Operation[14]						
Water						
Use (MLY)	1,930	1,340	5,808	971	2,283	0

Percent of groundwater allotment	NA	NA	85	NA	29[15]	NA
Percent change from current use	-<1	-31	5.2	<1	135	-100
Percent change from No Action use	NA	-31	<1	<1	64	-100
Discharge (MLY)	702	794	694	462	1,048	0
Percent change from current discharge	-21	-10	<1	16	39	-100
Percent change from No Action Discharge	NA	13	<1	1.3	39	-100
Socioeconomics						
Total site workforce (all missions)	3,179	2,928[16]	6,740	8,249	8,501	0
Nonnuclear workforce	2,508	2,257[16]	315[17]	114[17]	1,160	0
Change from No Action in total jobs (direct and indirect)	NA	-694[19]	240	131	2,510	-8,788
Waste Management	Small quantities of LLW would continue to be generated. Mixed waste would no longer be generated.	Existing facilities adequate; the generation of LLW and hazardous waste would be reduced.	Waste generation volumes would increase slightly. LANL has adequate existing waste management facilities.	Waste generation volumes would increase slightly. LLNL has adequate existing waste management facilities.	Waste generation volumes would increase slightly. SNL has adequate existing waste management facilities.	Hazardous wastes from operations would no longer be generated, but D&D activities during phaseout would generate some hazardous wastes.

Table 3.7.1-3.--*Summary Comparison of Impacts for the Pit Fabrication Mission*

	No Action	Reestablish at LANL	Reestablish at SRS
		Construction/Modification	
Land			
Disturbed land (ha)	0	0	0
Percent of available land	0	0	0
Threatened and Endangered Species			
Potentially affected	None	None	None

Socioeconomics			
Peak worker (direct)	0	138	288
Total jobs (direct and indirect)	0	228	516
Operation[18]			
Water			
Use (MLY)	0	5,790	13,295
Percent of groundwater allotment[19]	0	85	NA
Percent change from current use	0	4.9	6
Percent change from No Action use	NA	0.5	0.3
Discharge (MLY)	0	705	746
Percent change from current discharge	0	1.8	6
Percent change from No Action discharge	0	1.8	7
Socioeconomics			
Total site workforce (all missions)	0	6,806	20,101
Pit fabrication workforce	0	628[20]	813
Change from No Action in total jobs (direct and indirect)	0	260	2,407
Human Health			
Normal Operations			
Annual population dose (person-rem) (Incremental except for No Action)	0	8.6x10-5	5.9x10-4
25-year fatal cancers (Incremental except for No Action)	0	1.1x10-6	7.4x10-6
Annual worker dose (mrem/yr) (total)	0	380	380
25-year fatal cancer risk (total)	0	3.8x10 -*3*	3.8x10 -*3*
Accidents			
Complete Set (EBAs and BEBAs)[21]			
Expected consequences (fatalities)	NA	1.2x10-4	5.4x10-5
Expected risk (fatalities per year)	NA	6.2x10-6	2.8x10-6
Waste Management	NA	TRU, LLW, and hazardous waste generation would increase slightly. Existing waste management facilities are adequate.	TRU, LLW, and hazardous waste generation would increase slightly. Existing waste management facilities are adequate.

Table 3.7.1-4.--*Summary Comparison of Impacts for the Secondary and Case Fabrication Mission*

	No Action	Downsize ORR	Transfer to LANL [22]	Transfer to LLNL [22]	Phaseout at Y-12
Construction/Modification					
Land					
Disturbed land (ha)	0	0	0	0	0
Percent of available land	0	0	0	0	0
Threatened & Endangered Species					
Potentially affected	None	None	None	None	None
Socioeconomics					
Peak worker (direct)	0	14	55	130	0
Total jobs (direct and indirect)	0	29	91	324	0
Operation [23]					
Water					
Use (MLY)	14,760	13,820	5,815	1,161	12,310
Percent of groundwater allotment[24]	NA	NA	86	NA	NA
Percent change from current use	4	-3	5.4	20	-13
Percent change from No Action use	NA	-6	1.0	20	-17
Discharge (MLY)	2,277	2,147	713	558	1,827
Percent change from current discharge	71	62	2.9	40	38
Percent change from No Action discharge	NA	-5.7	2.9	22	-20
Socioeconomics					
Total site workforce (all missions)[25]	4,721	4,508	6,867	8,479	1,385
Secondary and case workforce	2,741	1,376[26]	523[27]	760 [28]	0
Change from No Action in total jobs (direct & indirect)	NA	-2103 [29]	321	1,012	-13,470

Human Health					
Normal Operations					
Annual population dose (person-rem) (Incremental except for No Action)	40.2	0.6	0.5	0.84	-0.2
25-year fatal cancers (Incremental except for No Action)	0.51	7.5x10 *-3*	6.3x10 *-3*	1.1x10 *-2*	*-2.5x10-3*
Annual worker dose (mrem/yr) (total)	2.2	2.2	2.2	2.2	0
25-year fatal cancer risk (total)	2.2x10-5	2.2x10 *-5*	2.2x10 *-5*	2.2x10 *-5*	*0*
Complete Set (EBAs and BEBAs) [30]					
Expected consequences (fatalities)	[31]	0.02	0.02	0.063	NA
Expected risk (fatalities per year)	[31]	1.2x10-6	1.2x10-6	3.8x10-6	NA
Waste Management	Spent nuclear fuel, TRU, LLW, mixed waste, hazardous waste, and nonhazardous waste would continue to be generated.	All waste generation would decrease. Existing and planned waste management facilities would be adequate.	Waste generation volumes would increase slightly. Existing waste management facilities are adequate.	Waste generation volumes would increase slightly. Existing waste management facilities are adequate.	Wastes generated by operation of the mission would be eliminated. Existing and planned waste treatment facilities are adequate.

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1 A/D mission includes impacts from strategic reserve storage.

2 Data shown is for transfer of entire HE fabrication mission to LANL or LLNL. HE fabrication could be shared at LANL and LLNL.

3 All data for operations are based on three shift except for No Action, which is based on one shift.

4 Percent groundwater allotment only applies to LANL.

5 Three-shift operation; single-shift operation would be 800 A/D direct workers and 624 support workers.

6 Three-shift operation; single-shift operation would be 31 HE direct workers.

7 At LANL, 67 of the 200 jobs would be new jobs.

8 At LLNL, 100 of the 232 jobs would be new jobs.

9 Three-shift operation; single-shift operation would result in a loss of 408 (189 direct and 219 indirect) jobs.

10 Three-shift operation; single-shift operation would result in a loss of 475 (220 direct and 255 indirect) jobs.

11 Impacts to population out to 80 km (50 mi).

12 Appendix F provides reference to existing documents of No Action accidents. Appendix section F.3 describes a comparison of accidents for No Action versus accidents associated with downsizing. NA - not applicable; EBA - evaluation basis accident; BEBA - beyond evaluation basis accident.

13 If nonnuclear fabrication were transferred to LANL, LLNL, and SNL, impacts of phaseout at KCP would also occur.

14 All data for operations are based on three-shift except for No Action, which is based on single-shift.

15 This number represents 29-percent of the Kirtland Air Force Base groundwater rights. SNL can obtain water from other groundwater sources.

16 Three-shift operation, single-shift operation would be 1,669 nonnuclear direct workers and 671 support workers.

17 At LANL, 194 of the 315 jobs would be new jobs. f At LLNL, 60 of the 114 jobs would be new jobs. **g** Three-shift operation; single-shift operation would result in a loss of 2,319 (839 direct and 1480 indirect) jobs. NA - not applicable.

18 All data for operations are based on three shift except for No Action, which is based on one shift.

19 Percent groundwater allotment only applies to LANL.

20 At LANL, 260 of the 628 jobs would be new jobs.

21 Impacts to population out to 80 km (50 mi). NA - not applicable; EBA - Evaluation Basis Accident; BEBA - Beyond Evaluation Basis Accident.

22 If secondary and case fabrication mission were transferred to LANL or LLNL, impacts of phase-out at Y-12 would also result.

23 All data for operations based on three shift except for No Action, which is based on one shift.

24 Percent groundwater allotment only applies to LANL.

25 Total site workforce is for Y-12 only.

26 Three-shift operation, single-shift operation would be 784 secondary and case direct workers and 1,980 support and other workers. 1,152 workers would support D&D of the facilities vacated by downsizing.

27 At LANL, 321 of the 523 jobs would be new jobs.

28 At LLNL, 290 of the 760 jobs would be new jobs.

29 Three-shift operation; single-shift operation would result in a loss of 4,200 (805 direct and 3,395 indirect) jobs.

30 Impacts to population out to 80 km (50 mi).

31 Appendix F provides reference to existing documents for No Action accidents. Section F.3 describes a comparison of accidents for No Action versus accidents associated with downsizing.
NA - not applicable; EBA - Evaluation Basis Accident; BEBA - Beyond Evaluation Basis Accident.

4.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

Chapter 4 describes the affected environment and the environmental impacts associated with stockpile stewardship and management alternatives. The chapter begins with an overview of applicable environmental assessment methodologies. The affected environment and environmental impacts of stockpile stewardship and management facilities are then discussed for each of the following sites: Oak Ridge Reservation, Savannah River Site, Kansas City Plant, Pantex Plant, Los Alamos National Laboratory, Lawrence Livermore National Laboratory, Sandia National Laboratories, and Nevada Test Site. Each discussion begins with a brief site description and the stockpile stewardship and management alternatives being considered for that site, continues with a description of the affected environment at the site, and concludes with a description of environmental impacts, a sensitivity analysis for management alternatives, and potential mitigation measures. The general potential environmental impacts of next generation stockpile stewardship facilities and underground nuclear testing are discussed in separate sections. Following the sections that address individual sites, are discussions of potential impacts from intersite transportation, cumulative impacts, and several issues that are common to all sites: unavoidable adverse environmental impacts, the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, irreversible and irretrievable commitments of resources, and facility transition.

Discussions of the environment that may be affected at each alternative site, and the associated environmental impacts that would result from the Stockpile Stewardship and Management Program make up the core of this chapter. In accordance with Council on Environmental Quality (CEQ) regulations, the affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment" (40 CFR 1508.14). The environmental impacts sections provide the analytical basis for the comparisons of potential impacts of the various stockpile stewardship and management facilities and the No Action alternative that are presented in chapter 3.

Affected Environment. The descriptions of the affected environment provide a basis for understanding the direct, indirect, and cumulative effects of the proposed Program and alternatives. The localities and characteristics of each potentially affected environmental resource are described for each site. The scope of the discussions varies by resource to ensure that all relevant issues are included.

For land resources, geology and soils, biotic resources, and cultural and paleontological resources, discussions of each Department of Energy (DOE) site and its surroundings are included along with descriptions of the representative area within that site that could be affected by the Program alternatives. This information provides a basis for understanding both direct effects and the overall resource base that could be affected by ancillary activities that may be defined in later stages of Program development.

Ambient conditions are described for air and water resources. Discussions focus on air conditions at site boundaries and the surface water bodies and groundwater aquifers that could be affected. This information serves as a basis for analyzing key air and water quality parameters to obtain results that can then be compared to regulatory standards.

Socioeconomic conditions are described for the counties and communities that could be affected by regional population changes associated with the proposed stockpile stewardship and management facilities. The affected environment discussions include projections of regional growth and related socioeconomic indicators. Each region is large enough to account for growth related to direct project employment as well as secondary jobs that may be created by the project.

In addition to those natural and human environmental resources discussed above, the affected environment sections include a number of issues related to ongoing DOE activities at each site. These issues involve facility operations and site infrastructure, intersite transport of nuclear materials, waste management, and radiological and hazardous chemical impacts during normal operation and from accidents. Where reasonably foreseeable changes to any of these factors can be predicted, they are discussed.

Environmental Impacts . In accordance with CEQ regulations, the environmental consequences discussions provide the analytical detail for comparisons of environmental impacts associated with the various stockpile stewardship and management facilities. Discussions are provided for each DOE site and each environmental resource and relevant issues that could be affected.

For comparison purposes, environmental concentrations of emissions and other potential environmental effects are presented with appropriate regulatory standards or guidelines. However, compliance with regulatory standards is not necessarily an indication of the significance or severity of the environmental impact for purposes of the *National Environmental Policy Act (NEPA)* of 1969.

The purpose of the analysis of environmental consequences is to identify the potential for environmental impacts. The environmental assessment methods used and the factors considered in assessing environmental impacts are discussed in section 4.1 and in the appropriate appendixes. The potential for impacts to a given resource or relevant issue is described in the introduction to each section within the site discussions (sections 4.2 through 4.9) that follow.

4.1 Environmental Resource/Issue Methodologies

4.1.1 Land Resources

This section considers land use plans and policies, zoning regulations, specially protected lands, and existing land use as appropriate for all sites. The potential impacts associated with changes to land use as a result of the alternatives are discussed.

Land use changes associated with upgraded and/or experimental stockpile stewardship facilities could occur in both rural and urban settings and could affect both developed and undeveloped land. The analysis of land use considers impacts that could result from the modification of existing facilities or the construction of new facilities on or adjacent to each site. Potential changes in land use are expected to occur within the existing boundaries of most, if not all, DOE sites. However, the use of lands adjacent to or in the vicinity of DOE sites (i.e., non-DOE land) could be affected by these changes, including new or expanded safety zones.

The degree to which the alternatives affect future use or development of land at each DOE site is considered. Land use impacts are assessed based on the extent and type of land that would be

affected. The land use analysis also considers potential direct impacts resulting from the conversion of, or the incompatibility of, land use changes with special status lands such as prime and unique farmlands, and other protected lands such as Federal- and state-controlled lands (e.g., public land administered by the Bureau of Land Management or other Government agencies).

4.1.2 Site Infrastructure

Changes to site infrastructure are assessed by overlaying the support requirements of the respective stockpile stewardship and management facilities upon the projected site infrastructure capacities. These assessments focus upon electrical power and fuel requirements. Projections of electricity availability, site development plans, and other DOE mid- and long-range planning documents are utilized to project site infrastructure conditions. Tables are presented that depict the additional infrastructure requirements resulting from the alternatives. Mitigation considerations that could reduce impacts due to changes in infrastructure are identified on a site-by-site basis.

4.1.3 Air Quality

The air quality assessment evaluates the consequences of criteria and hazardous/toxic air pollutants associated with each alternative at each site. The criteria pollutants are specified in 40 CFR 50, Environmental Protection Agency (EPA) Regulations on National Primary and Secondary Ambient Air Quality Standards. The hazardous/toxic air pollutants are listed in Title III of the 1990 Clean Air Act (CAA) Amendments, the National Emissions Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR 61), and standards or guidelines proposed or adopted by the respective states.

Air quality concentrations from modeling site emission rates projected to 2005 define No Action concentrations of pollutants. This programmatic environmental impact statement (PEIS) presents the estimated impacts on air quality based on No Action air quality conditions at each site and the projected impacts resulting from the alternatives and compares the total concentrations to the most restrictive Federal and/or state ambient air quality standards and guidelines.

The modeling of site-specific emissions was performed in accordance with EPA's Guideline on Air Quality Models. The EPA-recommended Industrial Source Complex Short-Term (ISCST) Model (Version 2) (EPA 1992f) was chosen as the most appropriate model to perform the air dispersion modeling analysis for this PEIS because it allows for the estimation of dispersion from a combination of point, area, and volume sources. Input data for the model was provided by DOE sites. For source characteristics that are not available, characteristics were estimated based on similar source configurations at sites employing similar processes.

EPA guidelines are conservatively applied in the air quality assessment. The "highest-high" was selected for comparison to applicable standards and guidelines for all averaging times, instead of the EPA-recommended "highest-high" and "highest second highest" concentration for long-term and short-term averaging times, respectively. The concentrations evaluated are the maximum occurring at or beyond the site boundary or public access roads. It was also assumed that the toxic/hazardous emissions for DOE sites with incomplete source characteristics originate from a single point source. This assumption generally results in higher concentrations than would actually occur since emission sources are commonly geographically separated from one another.

A more detailed and quantitative assessment will be performed in site-specific NEPA documents designed to support a construction-level siting decision. This PEIS assessment of impacts from the

No Action alternative and the other alternatives uses a screening level analysis and is based on conservative assumptions for modeling of potential impacts. The screening level modeling analysis presented in this document is a programmatic approach intended to provide a comparison of the air quality among each of the DOE sites. Modeled concentrations of air pollutants presented in this document that exceed the Federal or state air quality standards provide an indication of a potential problem, not a de facto exceedance. Detailed modeling and/or monitoring at each site would be required in order to obtain more accurate estimates of pollutant concentrations. The assessment in site-specific NEPA documents would be more refined with detailed design, source characteristics, and exact source locations.

Uncertainties. The performance of the ISCST Model has been evaluated with field data for its point source submodel (EPA 1977a; EPRI 1983a; EPRI 1985a; EPRI 1988a) and for its special features, such as gravitational settling/dry deposition option (EPA 1981a; EPA 1982a) and building downwash option (APCA 1986a; EPA 1981a). The ISCST Model is an extended version of the Single Source (CRSTER) Model; based on field data measured at four large power plants, it was concluded that the model was acceptable for predicting the upper percentile of the frequency distributions of 1-hour concentrations and of the corresponding distributions of 24-hour concentrations. The highest second-highest 1-hour concentrations were predicted within a factor of two at two-thirds of the field sampling sites for elevated power plant plumes. The ratio of the highest second-highest 24-hour concentration tended to be underpredicted by the model, with the ratio of predicted concentration to measured concentration ranging from about 0.2 to 2.7 at about 90 percent of the sampling sites (EPA 1977a:F-31).

In other validation studies for the Point Source Model, the CRSTER Model predicted peak short-term (i.e., 1-, 3-, and 24-hour) concentration values within 30 to 70 percent at a plain site (EPRI 1983a:7-1). The CRSTER Model predicted peak 1-hour concentrations within 2 percent and underpredicted peak 3-hour concentrations by about 30 percent at a moderately complex terrain site (EPRI 1985a:7-1). The ISCST Model overpredicts 1-hour concentrations by about 60 percent with better predictions for longer time periods at an urban site (EPRI 1988a:5-2). Uses of gravitational settling/dry deposition and building downwash options were found to improve the model performance significantly over that of the model without such features (APCA 1986a; EPA 1981a; EPA 1982a). The concentrations presented in this document are the highest concentrations predicted by the model in order to present conservative estimates of pollutant concentrations.

4.1.4 Water Resources

The quality and quantity of surface water and groundwater resources are described using available data. Potential effects on surface water and groundwater availability and quality are assessed.

Surface Water. Local surface water resources in the project region, flow characteristics and relationships, and stream classifications are used to describe current conditions. Data used for impact assessments include rates of water consumption and wastewater discharge for both construction and operation phases. Changes in the annual low flows of surface water resulting from proposed withdrawals and discharges are determined. In cases where low flow data are unavailable, average flow data are used. The existing water supply is evaluated to determine if sufficient quantities are available to support an increased demand by comparing projected increases with the capacity of the supplier and existing water rights, agreements, or allocations.

The water quality of potentially affected receiving waters is determined by reviewing current

monitoring data for nonradiological parameters. Potential impacts from radiological parameters are discussed in the radiological and hazardous chemical impacts sections of the normal operation and accidents sections. Focus is given to parameters that exceed applicable water quality criteria, as determined by the individual states. Monitoring reports for discharges permitted under the National Pollutant Discharge Elimination System (NPDES) program are examined for compliance with permit limits and requirements. The performance of each candidate DOE site in complying with the permit requirements is presented. In most cases, current design data do not include information on the constituents present or the rate of discharge. The assessment of water quality impacts from wastewater (sanitary and process) and stormwater runoff qualitatively addresses potential impacts to the receiving waters' minimum or average flow, as available and appropriate. Suitable mitigation measures for potential impacts such as stream channel erosion and sedimentation, stream bank flooding, and thermal changes are identified. Water quality management practices are also reviewed. If effluent constituent data are available, parameters with the potential to further degrade existing receiving water quality along with parameters exceeding existing NPDES permit limits are identified.

Floodplains are identified to determine whether any of the proposed stockpile stewardship and management facilities are located within a floodplain. Where possible, the proposed location is compared with the 500-year floodplain.

Groundwater. Groundwater resources are analyzed for effects on aquifers, groundwater usage, and groundwater quality within the regions. Groundwater resources are defined as the aquifers underlying the site and their extensions down the hydraulic gradients to, and including, discharge points. The affected environment discussion includes a description of the potentially affected groundwater basins. The local aquifers are described in terms of the extent, thickness, character of rock formations, and quality of the groundwater. Recharge areas are also noted. Total baseline groundwater use at the facility is compiled using the best available data. Groundwater usage is described and projections of future usage are made based on changing patterns of usage and anticipated growth patterns, whenever site-specific groundwater availability issues are identified.

Drawdown estimates are made both onsite and offsite. Short- and long-term impacts associated with construction withdrawals are estimated. Both proposed facilities and existing facilities are considered in determining cumulative impacts.

Available data on existing groundwater quality conditions are compared to Federal and state groundwater quality standards, effluent limitations, and safe drinking water standards. Additionally, Federal and state permitting requirements for groundwater withdraw and discharge are identified. Impacts of groundwater withdrawals on existing contaminant plumes due to construction and facility operation are assessed to determine the potential for changes in their rates of migration and the effects of any changes in the plumes on groundwater users. Impacts are assessed by the degree to which groundwater quality, drawdown of groundwater levels, and groundwater availability to other users would be affected. Impacts on groundwater quality are presented when effluent constituent data are available

4.1.5 Geology and Soils

Geology. Impacts to the geological environment considers destruction of or damage to unique geological features, subsidence caused by groundwater withdrawal, and landslides or shifting caused by loading or removal of supporting rock or soil. The local geology that could affect the alternatives, including geomorphology, stratigraphy, structural attitude of rocks, faults and seismicity, general

foundation, and boring conditions, are described as appropriate for each alternative site. The locations of faults are identified and an overview of the seismicity of the site areas, including the history and significance of earthquakes, along with their intensity and ground acceleration, is presented. Areas of potentially unstable slopes and impacts to the stability of slopes by the removal or addition of large volumes of earth in construction are characterized.

Soils. Soil types at the proposed project sites are described and the capability of supporting construction of the proposed facilities is assessed. Shrinking or swelling of ground as a result of landscaping, irrigation, or construction dewatering and soil erosion susceptibility associated with construction are also addressed.

4.1.6 Biotic Resources

During construction, impacts to biotic resources, including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species, may result from land-clearing activities, erosion and sedimentation, and human disturbance and noise. Operations may affect biotic resources as a result of changes in land use, emission of radionuclides, water withdrawal, wastewater discharge, and human disturbance and noise. In general, potential impacts are assessed based on the degree to which various habitats or species could be affected by an alternative. Where appropriate, impacts are evaluated with respect to Federal and state protection regulations and standards.

The analysis of impacts of project alternatives to biological resources is addressed at a level that is appropriate to the specificity of available information. In general, the analysis of impacts to biological resources presented in this PEIS is qualitative rather than quantitative. Quantitative analyses would be performed in site- and project-specific NEPA documentation.

Terrestrial Resources. Impacts of the proposed alternatives on terrestrial plant communities are evaluated by comparing data on site vegetation communities to proposed land requirements for construction and operation. The analysis of impacts to wildlife is based to a large extent on plant community loss or modification, which directly affects animal habitat. The loss of important or sensitive habitats and species is considered more important than the loss of regionally abundant habitats or species. Where appropriate, the disturbance, displacement, or loss of wildlife is evaluated in accordance with wildlife protection laws such as the *Migratory Bird Treaty Act* . Impacts on biotic resources from the release of radionuclides are not evaluated. Radiological releases associated with the various alternatives would generally be at or below natural background levels and would be within limits established to protect workers and the public. Since humans have generally been shown to be the most sensitive organism to radiation release these levels should also be protective of biota (AEC 1968a:220; NAS 1972a:34). Radiological effects on humans are addressed in the human health sections.

Wetlands. The potential direct loss of wetlands resulting from construction and operation of the proposed alternatives is addressed in a way similar to the evaluation of impacts on terrestrial plant communities; that is, by comparing data on site or regional wetlands to proposed land requirements. Sedimentation impacts are evaluated based on the proximity of wetlands to project areas and with the knowledge that an erosion control and sedimentation plan would be required. Impacts resulting from wastewater discharge into a wetland system are evaluated, recognizing that effluents would be required to meet Federal and state standards.

Aquatic Resources. Impacts to aquatic resources resulting from sedimentation and wastewater

discharge are evaluated as described for wetlands. Potential impacts from radionuclides are not addressed for the same reasons described for terrestrial resources. Where appropriate, impingement and entrainment impacts are evaluated as is compliance with protective measures, such as the *Anadromous Fish Conservation Act* .

Threatened and Endangered Species. Impacts on threatened and endangered species are determined in a manner similar to that used to describe terrestrial and aquatic resources since the sources of potential impacts are similar. A list of species potentially present on each site or in proximity to the site or region (appendix C) was developed using information obtained from the U.S. Fish and Wildlife Service (USFWS) and appropriate state agencies. This list, along with consideration of site environmental and engineering data, and provisions of the *Endangered Species Act* valuate whether the various alternatives could impact any threatened or endangered plant or animal (or its habitat).

Species that are Federal proposed or candidates for listing as threatened or endangered species do not receive legal protection under the Endangered Species Act. However, the USFWS recommends that impacts to these species be considered in project planning since their status can be changed to threatened or endangered in the foreseeable future. The USFWS has recently changed the classification of species under review for listing as threatened or endangered (61 FR 7596). Proposed species include those plants and animals for which a proposed rule to list as threatened or endangered has been published. Candidate species include those plants and animals for which the USFWS has on file sufficient information on biological vulnerability and threat to support issuance of a proposed rule for listing as threatened or endangered. Candidate species previously included Category 1 (species appropriate for listing as protected) and Category 2 (species possibly appropriate for listing as protected). Due to the recent rule change, candidate species include only those which are appropriate for listing as protected species (i.e., species formerly listed as Category 1). The Category 2 designation has been omitted. Some of the species previously identified as Federal candidate Category 2 in the Draft PEIS also have a state status and continue to be evaluated for potential impacts. However, due to the change in candidate classification described above, many species have been eliminated from proposed site threatened and endangered species lists.

4.1.7 Cultural and Paleontological Resources

Included in these sections are evaluations of the impacts of the Stockpile Stewardship and Management Program alternatives on prehistoric, historic, Native American, and paleontological resources. The effects considered include those resulting directly from land disturbance during construction, visual intrusion to the settings or environmental context of historic structures, visual and audio intrusions on Native American sacred sites, reduced access to Native American traditional use areas, unauthorized artifact collecting, and vandalism. Laws, regulations, Executive orders, and DOE orders mandating protection of cultural and paleontological resources are described for each site in chapter 5.

Prehistoric Resources. Prehistoric resources are physical properties resulting from human activities that predate written records. They are generally identified as either isolated artifacts or sites. Sites may contain concentrations of artifacts (e.g., stone tools and ceramic sherds), features (e.g., remains of campfires and houses), and plant and animal remains. Depending on their age, complexity, integrity, and relationship to one another, sites may be important for and capable of yielding information about past populations and adaptive strategies. The affected environment section for prehistoric resources includes a brief overview of the number and types of prehistoric sites in the

project areas, if known, and their status on the National Register of Historic Places (NRHP). The overview consists of a summary of existing information about prehistoric resources in the region and a discussion of types of sites that are likely to occur.

Impact assessments for prehistoric resources focus mainly on those properties likely to be eligible for the NRHP. Impacts are assessed by considering whether or not the proposed action could substantially add to an existing disturbance of resources in the project areas, adversely affect NRHP-eligible resources, or cause loss of or destruction to important prehistoric resources.

Historic Resources. Historic resources consist of physical properties that postdate the existence of written records. In the United States, historic resources are generally considered to be those that date from 1492 onward. Historic resources include architectural structures or districts (e.g., buildings, dams, and bridges), objects, and archaeological features (e.g., foundations of mills or residences, trails, and trash dumps). Ordinarily, sites less than 50 years old are not considered historic for analytical purposes, but exceptions can be made for younger properties if they are of exceptional importance (e.g., structures associated with Cold War themes [36 CFR 60]). The affected environment section for historic resources includes a brief overview of the number and types of historic sites in the project areas, if known, and their status on the NRHP. The overview consists of a summary of existing information about historic resources in the region and a discussion of the types of sites that are likely to exist.

Impact assessments for historic resources focus mainly on those properties likely to be eligible for the NRHP. Impacts are assessed by considering whether or not the proposed action could substantially add to an existing disturbance of resources in the project areas, could adversely affect NRHP-eligible resources, or could cause loss of or destruction to important historic resources.

Native American Resources. Native American resources are sites, areas, or materials important to Native Americans for religious or heritage reasons. In addition, cultural values are placed on natural resources such as plants, which have multiple purposes within various Native American groups. Of primary concern are concepts of sacred space that create the potential for land-use conflicts. Native American concerns would be identified through direct consultation with tribal representatives and field visits with tribal religious specialists during preparation of project-specific tiered NEPA documents. Contacts would be identified by reference to the ethnographic literature, by state and national pantribal organizations, and by agency and academic anthropologists.

The individual resource type, the proximity of impact areas to the resources, and the likely duration of impacts are considered in the analysis of Native American resources. Specific concerns include the relative importance of the resource in the Native American physical universe or religion, the distance at which activities in the vicinity of a sacred area constitute a disturbance, the extent to which affected resources may be restored, and the extent to which alternative sources for raw materials are available and/or suitable. Impacts to Native American resources are assessed by considering whether or not the proposed action has the potential to affect sites important for their position in the Native American physical universe or belief system, or the possibility of reducing access to traditional use areas or sacred sites.

Paleontological Resources. Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age. They include casts, molds, and trace fossils such as burrows or tracks. Fossil localities typically include surface outcrops, areas where subsurface deposits are exposed by ground disturbance, and special environments favoring preservation, such as

caves, peat bogs, and tar pits. Paleontological resources are important mainly for their potential to provide scientific information on paleoenvironments and the evolutionary history of plants and animals. The affected environment section for paleontological resources includes a description of known paleontological localities and geological formations in the project areas that may be fossil bearing.

Impact assessments for paleontological resources are based on the numbers and kinds of resources that could be affected, as well as the quality of fossil preservation in a given deposit, particularly in deposits with high research potential. Such deposits include poorly known fossil forms; well-preserved terrestrial vertebrates; unusual depositional contexts; assemblages containing a variety of fossil forms, particularly associations of vertebrates, invertebrates, and plants; or deposits recovered from poorly studied regions or in unusual concentrations.

4.1.8 Socioeconomics

These sections describe and assess impacts on local and regional socioeconomic conditions and factors including employment, economy, population, housing, and public finance. This PEIS assesses the socioeconomic impacts of both the gains and losses of missions at each site. The potential for socioeconomic impacts on population, housing, and local government finance is greatest in those local jurisdictions immediately adjacent to each site and those that are the residential locations of the majority of DOE site employees. Potential socioeconomic impacts on the economy (employment and income) are not bounded by local government jurisdictions but rather by industrial linkages to a regional market. Therefore, potential socioeconomic impacts are assessed using two geographic regions, a regional economic area, and a region of influence (ROI). Regional economic areas are used to assess potential effects on the economy. ROIs are used to assess effects which are more localized in political jurisdictions surrounding the sites.

The regional economic area for each site encompasses a broad market that involves trade among and between regional industrial and service sectors. It is characterized by strong economic linkages between the communities located in the region. These linkages determine the nature and magnitude of multiplier effects on economic activity (i.e., purchases, earnings, and employment) at each candidate site. Regional economic areas are defined by the U.S. Bureau of Economic Analysis as consisting of an economic node that serves as the center of economic activity and the surrounding counties that are economically related and include the places of work and residences of its labor force.

The U.S. Bureau of Economic Analysis measures multiplier effects of interindustry linkages with the Regional Input-Output Modeling System (RIMS II). RIMS II is based on an accounting framework called an input-output table. An input-output table shows, for each industry, industrial distributions of inputs purchased and outputs sold. RIMS II Total Direct-Effect Multipliers are used in this PEIS to estimate additional regional employment and income generated by employment and income directly associated with the proposed alternatives. RIMS II is also used to estimate the effects of jobs and income lost in a region due to downsizing or phaseout.

Additional potential demographic impacts were assessed on a smaller geographic area (ROI) where the housing market and community public finances could be most affected. Proposed Program alternatives at alternative sites were assessed using a site-specific ROI, comprising those local jurisdictions likely to experience the greatest socioeconomic impacts. The ROI is defined as those counties where approximately 90 percent of the current DOE and contractor employees reside. This

residential distribution reflects existing commuting patterns and attractiveness of area communities for people employed at each site, and is used to estimate the future distribution of direct workers with the proposed alternative. The evaluation of impacts is based on the degree to which changes in employment and population affect the regional economy, housing market, and public finance. It is assumed that most new or lost jobs would occur within the ROI where the majority of DOE and contractor employees live. The changes to these factors are projected to 2030 because the projected life of the DOE facilities for the alternatives under study is 25 years starting in 2005. The following sections discuss each of the socioeconomic conditions and factors considered.

Employment. The construction and operation of stewardship and management technologies and facilities could affect employment at DOE sites. Changes in site employment would, in turn, directly affect local and regional populations, economies, housing, and public finance. Current employment at each site is described, as well as projected employment associated with other planned DOE initiatives. Socioeconomic trends and the relationship of site employment to these trends are examined for each potentially affected socioeconomic region. Emphasis is placed on evaluating total direct and indirect employment changes and impacts associated with potential mission relocations.

Economy. The regional economies surrounding each site are characterized. Emphasis is placed on the measurement of the relative contribution and importance of each site's employment payroll and purchases to the economy. Changes to regional economic conditions are evaluated based on each site's relative contribution and changes to employment. Emphasis is placed on the economic effects of mission changes associated with the operation of stewardship and management technologies and facilities.

Population. The demographic changes in the ROI surrounding each site are described and assessed. Demographic characteristics are presented for the site's ROI to support the assessment of socioeconomic impacts. Trends are identified and used to project demographic changes over the environmental baseline period. Cumulative population impacts include the population impacts of other DOE actions under consideration, including planned environmental restoration activities.

Housing. Changes in employment at each site would affect the demand and supply of housing units, including the need for temporary housing (e.g., rental units) to support in-migrating construction workers. Trends in the housing availability within each site's socioeconomic ROI are characterized and evaluated. Numbers of in-migrating and out-migrating site employees associated with each of the alternatives are then used to evaluate housing impacts.

Public Finance. Each site is located on land owned by the Federal Government, which exempts these lands from state and local taxation. However, all employee income, property, and purchases are subject to applicable Federal, state, and local taxation requirements.

The additional workforce associated with any of these alternatives is small, and would require few in-migrating workers. For that reason, there would be little increased demand on specific community services. However, there would be fiscal impacts associated with additional missions or the phaseout of existing missions which could affect the community's ability to provide basic infrastructure and services. Therefore, the fiscal impacts on each site's ROI are assessed for counties, cities, and school districts, rather than the change in demand for specific community services. For a more detailed discussion of public finance, see appendix D.

4.1.9 Radiation and Hazardous Chemical Environment

4.1.9.1 Normal Operation

Public Health Risks. The risks to the general public during the 25-year operational interim are determined in three ways. Radiological releases/doses, which are conveyed in site-specific reports, are used to calculate risks associated with predicted baseline (No Action) operations in 2005. Incremental radiological/chemical doses and respective subsequent risks for management alternatives associated with each applicable site examined in this PEIS are calculated (modeled) via predicted release quantities supplied by "technology-specific" data reports and from site-dependent parameters. Incremental radiological/chemical doses and respective subsequent risks associated with certain proposed stewardship alternatives (on a per site basis) pursuant to this PEIS, are directly referenced from technology-specific or site-specific data reports.

Radiological Impacts. The assessment of incremental (or decremental) impacts incurred at each of the DOE sites are performed using the GENII computer code. This type of assessment uses such site-dependent factors as meteorology, population distributions, agricultural production, and an assumed facility location on a given site. Health risks to the maximally exposed individual and population within 80 kilometers (km) (50 miles [mi]) at Oak Ridge Reservation (ORR), Savannah River Site (SRS), Pantex Plant (Pantex), Sandia National Laboratories (SNL), and Nevada Test Site (NTS) are analyzed for each management and/or stewardship alternative, with the assumption that any two or more alternatives (with the exception of No Action) are not concurrently existing. At Los Alamos National Laboratory (LANL) and Lawrence Livermore National Laboratory (LLNL) however, a cumulative calculation is provided which includes all possible alternatives simultaneously existing at each respective site.

Resulting doses are compared with regulatory limits, and for perspective, are also compared with background radiation levels in the area of the site. These doses are then converted into the projected number of fatal cancers using a dose-to-risk conversion factor of 500 fatal cancers per 1,000,000 person-rem ($5x10^{-4}$ fatal cancers per person-rem) derived from data presented in a report prepared by the National Research Council's Committees on the Biological Effects of Ionizing Radiations (BEIR V) and also cited in the *1990 Recommendations of the International Commission on Radiological Protection* . The calculated health effects from each of the alternatives are then compared to one another (including the No Action alternative).

Hazardous Chemical Impacts. Public health risks from hazardous chemical releases during normal operation at the respective DOE sites are assessed by essentially the same analytical approach using conservative assumptions. This conservative approach is applied uniformly to all alternative sites using guidance provided under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The initial assessment in risk analysis is considered a screening step that was determined to be the appropriate level of analysis for this PEIS. Under this guidance, if the Hazard Index (HI) is 1x10-*6* (the default value, not a regulatory standard), no further analysis is indicated. A cancer risk of 1x10-*6* is considered acceptable by EPA (40 CFR 300.430) because this incidence of cancers cannot be distinguished from the cancer risk for an individual member of the general population.

Engineering designs used for the stockpile stewardship and management process and/or storage facilities include the anticipated emissions of hazardous chemicals. From emission data, concentrations at the site boundary are assumed to represent the maximum that any member of the public will encounter; therefore, the site boundary concentrations are derived through the ISCST

Model (version 2) recommended by EPA. The noncancer risks of the maximally exposed individual of the public will consist of hazard quotients (HQs) that compare chemical exposure levels to the reference concentration values published by EPA in the Integrated Risk Information System. The cancer risk to the maximally exposed individual is calculated from the doses derived from modeling exposure levels, using slope factors or unit risks for individual chemicals published in the Integrated Risk Information System or the health effects summary tables. The health effects summary tables are the yearly summary of EPA's regulatory toxicity data. The HI values (i.e., the sum of the HQs) and cancer risks are conservative because a single source and a single point at the site boundary are chosen for the calculations. The cancer risks are also conservative due to the single point concentration and the position where the exposure is assumed to occur. The HI is independent of the cancer risk.

The HIs and cancer risks are used as screening tools to identify potential health concerns that may require further analysis. If the HI meets OSHA standards and cancer risks are within the default value, then further analysis is most likely not warranted. However, if in the conservative approach, there are sites or activities wherein the HI and/or cancer risk exceed acceptable limits, then these sites or activities become candidates for further in-depth analysis. The in-depth analysis should identify the individual chemicals that contribute to substantial adverse HI and/or cancer risk impacts, starting with those chemicals showing the highest HQs and/or cancer risk and grouping them according to their specific health effects. These chemicals then may be identified for inclusion in more specific site analyses. It should be noted that when the OSHA standards for HIs and/or the cancer risk default value are exceeded, a health concern may not necessarily exist. This PEIS does not purport to provide the level of detail needed to go beyond a conservative screening process for hazardous chemicals. As such, the analysis in this PEIS for the No Action alternative should not be relied upon as a basis for judging whether the sites have a health concern. The model used to calculate HI and cancer risk in this PEIS only establishes a baseline for comparison of alternatives among different sites. The baseline is then used to determine the extent to which each alternative adds or subtracts from the No Action HI and cancer risk to the public at each site.

Information pertaining to OSHA-regulated permissible exposure limits, reference concentrations, reference doses, cancer slope factors (if any), and toxicity profiles for all hazardous chemicals described in this PEIS may be found in the *Chemical Health Effects Technical Reference* (TTI 1996b.)

Occupational Health Risks. Health risks are assessed for two types of workers. The first type is the involved worker who would be located inside a facility that is involved with any of the given alternatives being examined. The second type is the noninvolved worker who would be located somewhere else on a given site but is not involved with occupational tasks associated with any of the given alternatives.

Radiological Impacts. Involved worker exposures are either based on values reported in technology-specific data reports or in occupational dose histories for similar operations. The doses to noninvolved workers at each respective site are determined based on occupational dose histories; in most cases for these workers, impacts associated with normal operation for each management and/or stewardship alternative are assumed to be negligible compared with those associated with their primary onsite activities. Worker impacts associated with each alternative at ORR, SRS, Pantex, SNL, and NTS are analyzed with the assumption that any two or more alternatives (with the exception of No Action) are not concurrently existing. At LANL and LLNL however, a cumulative calculation is reported that includes all possible alternatives simultaneously existing at each

respective site.

The worker doses are converted into the number of projected fatal cancers using the dose-to-risk conversion factor of 400 fatal cancers per 1,000,000 person-rem (4x10-4 fatal cancers per person-rem) given in ICRP Publication 60. This lower risk estimator, compared with that for members of the public, reflects the absence of children in the workforce.

Hazardous and Toxic Chemical Impacts. Since direct chemical monitoring data on worker exposure is not available for specific operations, the onsite worker is assumed to receive the maximum exposure any involved or noninvolved onsite person will receive. OSHA-regulated levels (i.e., permissible exposure levels) are applied to all hazardous chemicals that are released at the site. This includes both the project-specific releases as well as those that are a result of other site operations. All onsite exposures are assumed to occur at a distance of 100 meters (m) (330 feet [ft]) from a centralized point of release, which will yield a conservative concentration level for each chemical. The concentrations are derived through the ISCST Model recommended by EPA. The noncancer risks to the onsite worker consist of HQs that compare chemical exposure levels to the permissible exposure level values established by OSHA. The HI for each alternative is the sum of all HQs for the alternative. The cancer risks to the onsite worker are calculated from doses derived from modeled exposure level, using slope factors or unit risks for individual chemicals published in the Integrated Risk Information System or the health effects summary tables . The worker exposure is based on an 8-hour day and 52 weeks of 40 hours each (i.e., 0.237 fractional year). The HI values and cancer risks are conservative because a single point at 100 m (330 ft) from a centralized source term is chosen for the calculations. The cancer risks are conservative due to the single point concentration and the position where the exposure is assumed. The HI is independent of cancer risk. The cancer risks to the facility worker for each chemical are computed from the dose (converted from air concentrations) and the unit risk or slope factors to yield a probable risk. The risks are also conservative because a single point at or near the maximum onsite concentration is selected for calculating the exposure of the facility worker.

As described for public health risks, this conservative approach is applied uniformly to workers at all sites using guidance under CERCLA. Under this guidance, if the HI is $1x10^{-6}$ (the default value, not a regulatory limit), no further analysis is indicated. If the HI exceeds the OSHA standards and/or the cancer risk exceeds the default value, a need for a more in-depth analysis of the data is indicated. It should be noted that when the OSHA standards for HIs and/or the cancer risk default value are exceeded, a health concern may not necessarily exist. The model used to calculate HI and cancer risk in this PEIS only establishes a baseline for comparison of alternatives among different sites. The baseline is then used to determine the extent to which each alternative adds or subtracts from the No Action HI and cancer risk for workers at each site.

Information pertaining to OSHA-regulated permissible exposure limits, reference concentration, reference doses, cancer slope factors (if any), and toxicity profiles for all hazardous chemicals described in this PEIS may be found in the *Chemical Health Effects Technical Reference* (TTI 1996b).

Epidemiological Studies . In March 1990, the Secretary of Energy announced that DOE would turn over responsibility for analytical epidemiologic research on long-term health effects on workers at DOE facilities and the public in surrounding communities to the Department of Health and Human Services. Further, DOE directed that this worker and public health and exposure data be released. A Memorandum of Agreement with the Department of Health and Human Services was signed in

January 1991. The Department of Health and Human Services is now conducting the ongoing health effects research program. The National Institute for Occupational Safety and Health also initiated a study in 1994 but does not expect the results before 1997. Discussions are presented of past and ongoing health studies for each site.

4.1.9.2 *Facility Accidents*

Accident Analysis for Postulated Accident Scenarios. The relative consequences of postulated accidents in the evaluation of each alternative are considered. In evaluating the magnitude and consequences of each alternative, a suitable accident analysis is performed to produce results for decision-making purposes. Although the concepts used are analogous to a formal Probabilistic Risk Assessment, which would be appropriate for a project-level analysis, the accident analysis involves considerably less detail and only addresses a representative spectrum of beyond design-basis accidents (high-consequence, low-probability) and a representative spectrum of possible operational accidents (low-consequence but high-probability of occurrence). The technical approach for the selection of accidents is consistent with the DOE Office of NEPA Oversight Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements (May 1993), which recommends consideration of two major categories of accidents: within design-basis accidents and beyond design-basis accidents.

For the purpose of this assessment, risk is defined as the mathematical product of the probability and consequences of an accident. Both probability and consequences are presented in this PEIS. The risk-contributing scenarios consider both design-basis and severe accidents. The specific accidents consider the types of facilities. Examples of accidents include those resulting from operator errors, spills, criticalities, fires, explosions, airplane crashes, common-cause failures, collocated facilities, severe weather, earthquakes, and transportation. Information on potential accidents includes those that have been postulated and analyzed for similar facilities. The risks of the various stockpile stewardship and management facilities are evaluated in terms of the incremental increase in risk and the cumulative effect of that risk with respect to normal day-to-day risks to which the general population is exposed.

For each alternative, a number of evaluation and beyond evaluation accidents have been identified and are generally referred to as the composite set of accidents. Two subsets of the composite set are also referred to as the composite set of evaluation basis accidents (EBAs) and the composite set of beyond evaluation basis accidents (BEBAs). Impacts are presented for the composite set of accidents to reflect the combined impacts of EBAs and BEBAs. The impacts for the composite set of EBAs are also provided to reflect the impacts of high-frequency/low-consequence accidents. Impacts for the composite set of BEBAs are provided to show the impacts of low-frequency/high-consequence accidents. EBAs are generally in a frequency range greater than 10-*6* per year, while BEBAs are generally in a frequency range of 10-*7* to 101x10-*6* per year. In some cases, accidents less than 10-*7* are included in the composite set of BEBAs.

Accident risk to collocated workers was calculated for a hypothetical worker at 1,000 m (3,281 ft) from the facility, or at the site boundary, whichever is closer. For distances less than 1,000 m (3,281 ft), the screening model techniques used in the programmatic level analyses are less effective because of the effects of buildings on meteorology and dispersion.dent scenarios addressed in this PEIS. Where information is available, risks to involved workers from accidents are presented. It should be noted that the purpose of this PEIS is to assist the decisionmaker in making programmatic site selection decisions. Since the activities are the same for a given stockpile management function

regardless of location, the risk to involved workers would be independent of site location and would not be a discriminating factor for programmatic siting decisions. Risk to workers from radiological accidents would be addressed in greater detail in site-specific tiered NEPA documents when more detailed information is available.

Sensitivity Analysis. Adequate data is not available to support a quantitative sensitivity analysis for accident impacts; therefore, a discussion of the subject is not presented in the accident discussion for the management alternatives in this PEIS. However, it is expected that higher case workloads could increase the quantity of hazardous materials at risk in an accident and the accident frequency. Therefore, this could result in a corresponding increase in accident impacts.

Uncertainties . The sequence of analyses performed to generate the radiological impact estimates from normal operation and facility accidents include selection of normal operational modes and accident sequences, estimation of source terms, estimation of environmental transport and uptake of radionuclides, calculation of radiation doses to exposed individuals, and estimation of health effects. There are uncertainties associated with each of these steps. Uncertainties exist in the way the physical systems being analyzed are represented by the computational models and in the data required to exercise the models due to measurement errors, sampling errors, or natural variability.

The analysis is designed to ensure--through judicious selection of release scenarios, models, and parameters--that the results represent the potential risks, and that there is a consistent basis for comparing alternatives. This is accomplished by making conservative assumptions in the calculations at each step.

The risk analysis presented in this PEIS is not a complete risk assessment in the sense of identifying and analyzing all physically possible accidents including those high consequence accidents whose probability is so remote as to render them not reasonably foreseeable. The accident analyses do include, however, a spectrum of reasonably foreseeable accidents including high consequence accidents and their associated risks for the technologies and facilities. These severe accidents have low accident frequencies, often less than 1.0x10-*6* per year. The accident analyses also include higher frequency accidents (evaluation-basis and other operational 1x10-*6* per year.

In summary, the radiological and hazardous chemical impact estimates presented in this document were obtained by:

- Using the best available data
- Considering the processes, events, and accidents that are reasonably foreseeable for the facilities described in this study and the environment
- Making conservative assumptions when there is doubt about the exact nature of the processes and events taking place
- Ensuring the consistency of analysis across alternatives

Emergency Preparedness. Emergency preparedness and planning has the effect of mitigating the consequences of facility accidents. Emergency preparedness plans exist for all sites and are summarized for each site.

4.1.10 Waste Management

A major effort of the Stockpile Stewardship and Management Program has been and would continue

to be the minimization of waste generation. The proposed alternatives would incorporate waste minimization and pollution prevention practices to the maximum extent practicable. Waste minimization efforts and the management of Program-related wastes are discussed for each DOE site. Waste management facilities that would support stockpile stewardship and management facilities would treat and package waste into forms that would enable long-term storage or disposal. For sites under consideration that do not have existing or planned onsite low-level waste (LLW) disposal, the number of additional shipments required to transport LLW from the site to a DOE LLW disposal facility is estimated. For example, for purposes of this analysis it is assumed that Pantex would ship its LLW to NTS as per current practice. The risks associated with additional shipments are addressed as part of the intersite transport assessment (section 4.10). Waste management activities that would support the Program are assumed to be per current site practice and are contingent upon decisions to be made through the Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (DOE/EIS-0200-D, August 1995). Any future waste management facilities that may be required to support the Program would be coordinated with any decisions resulting from the Waste Management PEIS and any respective site-specific NEPA documentation.

The construction and operation of stockpile stewardship and management facilities would generate several types of wastes. Generation points are in some cases different among alternative sites depending upon specific siting of various facilities. Construction wastes are similar to those generated by any construction project of comparable scale. Wastes generated during the operation of stockpile stewardship and management facilities consist of five primary types: transuranic (TRU), low-level, mixed, hazardous, and nonhazardous wastes. The types and amounts of waste vary according to the alternative and facility. For example, the Pit Fabrication Facility is the only facility projected to generate any TRU waste.

The nuclear weapons facilities provide for the short-term stabilization, staging, storage, and management of waste, including the means to minimize waste generation, until DOE either disposes of the waste or places it in long-term storage. To provide a framework for addressing the impacts of waste management for stockpile stewardship and management facilities, descriptive information is presented on the waste management activities anticipated for each DOE site. The volumes of each type of waste generated are estimated by facility and DOE site. These estimates have included waste minimization provisions. The impact assessment addresses the waste types and projected waste volumes from the various stockpile stewardship and management facilities at each site compared to No Action. Impacts are assessed in the context of existing site practices for treatment, storage, and disposal, including the applicable regulatory setting and requirements. Existing permits, compliance agreements, and other site-specific waste management practices were reviewed and analyzed to assess the ability to conduct the required activities.

Decontamination and decommissioning (D&D) activities are also addressed. Such activities depend upon the historic use of the facility and the final disposition of a facility. D&D activities could range from performing a simple radiological survey to completely dismantling and removing a radioactively contaminated facility. The D&D waste volumes from transition facilities no longer required for stockpile stewardship and management missions are estimated.

4.1.11 Environmental Justice

This PEIS assesses the potential for disproportionately high and adverse human health or environmental effects on minority and low-income populations in accordance with Executive Order

12898, *Federal Action to Address Environmental Justice in Minority Populations and Low Income Populations* . Because both the Federal Working Group on Environmental Justice and DOE are still in the process of developing guidance on criteria for identifying effects to these populations, the approach taken in this PEIS analysis may differ somewhat from whatever guidance may be issued.

This PEIS environmental justice analysis addressed selected demographic characteristics of the ROI (80 km [50 mi]) for each of the eight alternative sites. The analysis identified census tracts where racial or ethnic minorities comprise 50 percent, or a simple majority, of the total population in the census tract, or where racial or ethnic minorities comprise less than 50 percent but greater than 25 percent of the total population in the census tract. The analysis also identified low-income communities where 25 percent or more of the population is characterized as living in poverty (yearly income of less than $8,076 for a family of two). Impacts are assessed based on the analysis presented for each resource and issue area for each of the proposed alternatives at each site. Any disproportionately high and adverse human health or environmental effects on minority and low-income populations are discussed.

4.1.12 Cumulative Impacts

Cumulative impacts address the incremental effects of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (43 FR 55978; 40 CFR 1500-1508).

Other DOE programs (including environmental management missions) and other Federal, state, and local development programs all have the potential to contribute to cumulative effects on DOE sites. "Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7). To the extent information was available for these other actions at a given site, the cumulative impacts are presented.

Continuing Department of Energy Missions . Continuing DOE missions and any reasonably foreseeable changes to these missions are addressed as part of the affected environment baseline. Continuing missions at each site are discussed in the site infrastructure section of the affected environment discussion for each DOE site. These missions provide the baseline against which the stockpile stewardship and management facilities are compared. For example, water requirements for the proposed stockpile stewardship and management facilities are combined with requirements of continuing missions to assess the total impact to water resources.

Environmental Management Missions . Any planned and reasonably foreseeable new or modified waste handling facilities are discussed in the waste management section for each site. In addition, to the extent that other environmental management missions or strategies are planned and defined, they are also discussed as bounding environmental impacts of waste management actions. Specific waste management activities are being addressed in the Waste Management PEIS being prepared by the DOE Office of the Assistant Secretary for Environmental Management (EM).

Other Federal and State Programs. Other Federal and state programs are identified, but only planned, reasonably foreseeable programs are considered. Typical programs in this category include public works projects and military base closures and reuse projects. Potential consequences of any major programs that increase impacts when combined with the stockpile stewardship and management alternatives are presented.

Local Development Programs. Local development programs are not specifically identified. However, socioeconomic projections take into account anticipated regional growth. Local development programs are a part of this growth and are addressed collectively using growth as a substitute. Socioeconomic projections form the baseline for much of the environmental analysis presented in this document.

Approach for Cumulative Impact Assessments. There is no generic methodology for the assessment of cumulative impacts. Therefore, the following approach represents a design for analyzing programmatic cumulative impacts relative to past, present, and probable future activities. It incorporates a wide ranging view of DOE defense programs, environmental management, and other outside interactions. This strategy is integrated with detailed resource-specific assessment methods where appropriate, and can be developed further in site-specific tiered NEPA documentation to ensure compatibility across the DOE Office for the Assistant Secretary for Defense Programs (DP), EM, and other programs.

The rationale for this approach is that this PEIS is a programmatic document. The reference condition for cumulative effects is the No Action alternative. The strategy has four major components:

- Focus analysis primarily on the impacts at each stockpile stewardship and management site where other DP and/or EM activities are reasonably anticipated. Past, baseline, and future DP and EM activities are more clearly defined and have a higher degree of certainty than offsite activities. These activities tend to be much more speculative the further into the future they are planned.
- Address quantitatively cumulative impact analyses associated with offsite activities in site-specific, tiered NEPA documentation.
- Coordinate efforts between DP and EM activities through the Memorandum of Agreement between DP and EM
- Focus on site-specific cumulative effects from stockpile stewardship and management, addressing them in terms of both the temporal and spatial aspects of DP activities, as well as the level, phasing, and site-specific locations of proposed EM facilities and activities. This is appropriate due to the uncertainty and lack of specificity associated with offsite activities that could result in significant incremental, indirect, or synergistic cumulative impacts; these activities are more effectively addressed in site-specific, tiered NEPA documentation.

This method is flexible and allows for the assessment of cumulative impacts to regulated resources at a lower level of analysis due to the protection afforded to them through applicable regulations. In addition, the method recognizes that the focus on a given resource may vary according to site-specific characteristics of the local environment. Where these types of variations are identified, a level of analysis would be performed commensurate to the importance of the potential cumulative impacts on that resource.

4.2 Oak Ridge Reservation

ORR is a Government-owned, contractor-operated reservation located in the State of Tennessee. The regional location of ORR is shown in figure 4.2-1 and the principal facilities at ORR are shown in figure 4.2-2. The prime contractor manages the Y-12 Plant (Y-12), Oak Ridge National Laboratory (ORNL), the K-25 Site (K-25), and most other properties on the reservation. The facilities began operation in 1943 as part of the World War II Manhattan Project. The primary missions at each facility have changed over the past 50 years, with the current missions described in section 3.2.2. Although Y-12 is the main focus area with respect to the proposed actions, baseline environmental information and impact assessment are presented for ORR due to the proximity and potential impacts of nearby facilities, both present and future.

4.2.1 Description of Alternatives

No Action. ORR would continue to perform the missions described in section 3.2.2.

Stockpile Management Alternatives. The secondary and case fabrication mission could be consolidated and downsized, and remain at Y-12. In this scenario, storage of the strategic reserve of uranium would remain at Y-12. The Y-12 secondary and case fabrication mission could also be transferred to either LANL or LLNL. In the event the secondary and case fabrication mission is transferred to the laboratories, the DP missions at Y-12 would be phased out and the facilities transitioned to EM for disposition. In addition, the strategic reserve of uranium in the form of canned subassemblies would be relocated to the weapons assembly/disassembly (A/D) Facility at either Pantex or NTS.

Stockpile Stewardship Alternatives. There are no stockpile stewardship alternatives that include ORR.

4.2.2 Affected Environment

The following sections describe the affected environment at ORR for land resources, air quality, water resources, geology and soils, biotic resources, cultural and paleontological resources, and socioeconomics. In addition, the infrastructure at ORR, the radiation and hazardous chemical environment, and the waste management conditions are described.

4.2.2.1 *Land Resources*

ORR is located on approximately 13,980 hectares (ha) (34,545 acres) within the corporate limits of the city of Oak Ridge, approximately 19 km (12 mi) west of Knoxville, TN. All the land within ORR is owned by the Federal Government and is administered, managed, and controlled by DOE. Generalized land uses at ORR and in the vicinity are shown in figure 4.2.2.1-1.

Land uses within ORR can be grouped into four major land use classifications: industrial, forest/undeveloped, public/quasi-public, and water. The industrial areas account for approximately 4,700 ha (11,700 acres) or approximately 33 percent of the total site area. An additional 490 ha (1,200 acres) are used for a security buffer zone around various facilities. About 320 ha (800 acres) of ORR's land is classified as public land and consists mainly of the 36-ha (90-acre) Clark Center Recreational Park, numerous small public cemeteries, and an onsite public road (OR DOE 1989a:5-

10). The remaining area, about 8,700 ha (21,600 acres), consists of forest/undeveloped land, some of which is managed as pine plantations for production of pulpwood and saw timber. The DOE Water Treatment Facility, which provides water to many ORR facilities and the city of Oak Ridge, is located just north of Y-12. There are no prime farmlands on ORR.

In 1980, DOE designated approximately 5,500 ha (13,600 acres) of ORR undeveloped land as a National Environmental Research Park. The park is used by the national scientific community as an outdoor laboratory for environmental science research on the impact of human activities on the eastern deciduous forest ecosystem (DOE 1985a:3,27).

Land bordering ORR is predominately rural and used largely for residences, small farms, forest land, and pasture land. The city of Oak Ridge, along the northeast portion of the site, has a typical urban mix of residential, public, commercial, and industrial land uses. There are four residential areas along the northern boundary of ORR; each has several houses within approximately 30 m (98 ft) of the boundary.

Y-12 is largely developed and encompasses 328 ha (811 acres) of which 255 ha (630 acres) are enclosed by security fencing. Y-12 is the primary location used for supporting DP missions, including nuclear components production and surveillance and nuclear production mission assignments. These activities are housed in approximately 425 buildings containing 152,911 square meters (m^2) (5.4 million square feet [ft^2]) of floor space. *Y-12 also has approximately 20 buildings, containing 8,495 m2 (300,000 ft2)* of floor space, *that house support activities and several organizations of the DOE Oak Ridge Field Office.*

4.2.2.2 *Site Infrastructure*

To support the current missions at ORR, as described in section 3.2.2, an extensive infrastructure exists as shown in table 4.2.2.2-1. These resources support operations at Y-12, ORNL, and K-25.

Table 4.2.2.2-1.--*Baseline Characteristics for Oak Ridge Reservation.*

Characteristics	Current Value
Land	
Area (ha)	13,980
Roads (km)	71
Railroads (km)	27
Electrical	
Energy consumption (MWh/yr)	726,000
Peak load (MWe)	1110
Fuel	
Natural gas (m^3/yr)	95,000,000
Liquid (L/yr)	416,000
Coal (t/yr)	16,300
Steam	
Generation (kg/hr)	150,000
Water	

Usage (MLY)	14,210

OR LMES 1996i.

4.2.2.3 Air Quality

The following section describes existing air quality and reviews the meteorology and climatology in the vicinity of ORR. More detailed discussions of the air quality methodologies, input data, and atmospheric dispersion characteristics are presented in appendix section B.3.2.

Meteorology and Climatology. The Cumberland and Great Smoky Mountains have a moderating influence on the climate at ORR. Winters are generally mild and summers warm, with no noticeable extremes in precipitation, temperature, or winds.

The annual average temperature at ORR is 13.7 °Celsius (C) (56.6 °Fahrenheit [F]); the average daily minimum temperature in January is -3.8 °C (25.1 °F), and the average daily maximum temperature in July is 30.4 °C (86.7 °F). The average annual precipitation is approximately 136.6 centimeters (cm) (53.77 inches [in]). Prevailing wind directions at ORR tend to follow the orientation of the valley; up valley, from west to southwest; or down valley, from east to northeast. The average annual wind speed is approximately 2.0 meters per second (m/s) (4.5 miles per hour [mph]) (NOAA 1994c:3). Additional information related to meteorology and climatology at ORR is presented in appendix section B.3.2.

Ambient Air Quality. ORR is located in Anderson and Roane Counties in the eastern Tennessee and southwestern Virginia Interstate Air Quality Control Region (AQCR) 207. As of 1995, the areas within this AQCR were designated by EPA as attainment areas with respect to all National Ambient Air Quality Standards (NAAQS) for criteria pollutants (40 CFR 81.343). Applicable NAAQS and Tennessee State ambient air quality standards are presented in appendix table B.3.1-1.

One Prevention of Significant Deterioration Class I area can be found in the vicinity of ORR. This area, the Great Smoky Mountains National Park, is located approximately 48 km (30 mi) southeast of ORR. Since the promulgation of regulations, no Prevention of Significant Deterioration permits have been required for any emissions source at ORR.

The primary emission sources of criteria pollutants are the steam plants at Y-12, K-25, and ORNL. Other emission sources include fugitive particulates from coal piles, the Toxic Substances Control Act (*TSCA)* incinerator, other processes, vehicles, and temporary emissions from various construction activities (OR DOE 1987a:33-49). Appendix table B.3.2-1 presents emission rates of pollutants from ORR.

Table 4.2.2.3-1 presents the baseline ambient air concentration for criteria pollutants and other pollutants of concern at ORR. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Table 4.2.2.3-1.--***Comparison of Baseline Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines at Oak Ridge Reservation, 1992***

Pollutant	Averaging Time	Most Stringent Regulation or Guideline (g/m³)	Baseline Concentration (g/m³)
Criteria Pollutant			
Carbon monoxide	8-hour 1-hour	10,000[1] 40,000[1]	5 11
Lead	Calendar quarter	1.5 [1]	0.05 [2]
Nitrogen dioxide	Annual	100[1]	3
Ozone	1-hour	235[1]	[3]
Particulate matter	Annual 24-hour	50[1] 150[1]	1 2
Sulfur dioxide	Annual 24-hour 3-hour	80[1] 365[1] 1,300[1]	2 32 80
Mandated by Tennessee			
Gaseous fluoride (as hydrogen fluoride)	30-day 7-day 24-hour 12-hour 8-hour	1.2 [4] 1.6 [4] 2.9 [4] 3.7 [4] 250[4]	0.2 0.3 <0.6 <0.6 0.6
Total suspended particulates	24-hour	150[4]	2
Hazardous and Other Toxic Compounds			
Chlorine	8-hour	150[4]	4.1
Hydrogen chloride	8-hour	750[4]	57
Mercury	8-hour	5[4]	0.06 [5]
Nitric acid	8-hour	[6]	78
Sulfuric acid	8-hour	100[4]	20

4.2.2.4 *Water Resources*

This section describes the surface and groundwater resources at ORR.

Surface Water. The major surface water body in the immediate vicinity of ORR is the Clinch River, which borders the site to the south and west. There are four major subdrainage basins on ORR that flow into the Clinch River and are affected by site operations: Poplar Creek, East Fork Poplar Creek, Bear Creek, and White Oak Creek. Drainage from Y-12 enters both Bear Creek and East Fork Poplar Creek; K-25 drains predominantly into Poplar Creek and Mitchell Branch; and ORNL drains into the White Oak Creek drainage basin (OR DOE 1992c:1-16). Several smaller drainage basins, including

Ish Creek, Grassy Creek, Bearden Creek, McCoy Branch, Kerr Hollow Branch, and Raccoon Creek, drain directly to the Clinch River. Each drainage basin takes the name of the major stream flowing through the area. Within each basin are a number of small tributaries. The natural surface water bodies in the vicinity of ORR are shown in figure 4.2.2.4-1.

The Clinch River and connected waterways supply all raw water for ORR. The Clinch River has an average flow of 132 cubic meters (m $^{3)}$ /s (4,647 cubic feet [ft $^{3]}$ /s) as measured at the downstream side of Melton Hill Dam at mile 23.1. The average flow of Bear Creek near Y-12 is 0.11 m *3* /s (3.9 ft *3* /s). The average flow at East Fork Poplar Creek is 1.3 m *3* /s (45 ft *3* /s) (OR USGS 1986a:161,168-169). Y-12 uses approximately 7,530 million liters per year (MLY) (1,989 million gallons per year [MGY]) of water, while ORR uses approximately twice as much (14,760 MLY [3,900 MGY]). The ORR water supply system, which includes the DOE treatment facility and the K-25 treatment facility, has a capacity of 44,347 MLY (11,716 MGY).

At Y-12, there are six treatment facilities with NPDES-permitted discharge points to East Fork Poplar Creek. Y-12 is also permitted to discharge wastewater to the City of Oak Ridge Wastewater Treatment Facility. At ORNL, three NPDES-permitted wastewater treatment facilities discharge into White Oak Creek basin. K-25 operates one sanitary sewage system which discharges to Poplar Creek (OR DOE 1994c:4-17-4-19).

Clinch River water levels in the vicinity of ORR are regulated by a system of dams operated by the Tennessee Valley Authority. Melton Hill Dam controls the flow of the Clinch River along the northeast and southeast sides of ORR. Watts Bar Dam, located on the Tennessee River downstream of the lower end of the Clinch River, controls the flow of the Clinch River along the southeast side of ORR (ORNL 1986a:1-17).

The Tennessee Valley Authority has conducted flood studies along Clinch River, Bear Creek, and East Fork Poplar Creek. Portions of Y-12 lie within the 100- and 500-year floodplains of East Fork Poplar Creek; however, proposed alternative facilities are located outside the 500-year floodplain (ORR 1995a:6).

Surface Water Quality. The streams and creeks of Tennessee are classified by the Tennessee Department of Environment and Conservation and defined in the State of Tennessee Water Quality Standards. Classifications are based on water quality, designated uses, and resident aquatic biota. The Clinch River is the only surface water body on ORR classified for domestic water supply. Most of the streams at ORR are classified for fish and aquatic life, livestock watering, and wildlife (OR DOE 1992c:1-16). White Oak Creek and Melton Branch are the only streams not classified for irrigation. Portions of Poplar Creek, East Fork Poplar Creek, and Melton Branch are not classified for recreation.

Both routine and NPDES-required surface water monitoring programs (over 225 sites) are performed at Y-12 to assess the impacts of the plant effluents upon natural receiving water and to estimate the impacts of these effluents on human health and the environment. At Y-12, Bear Creek, McCoy Branch, Rogers Quarry, and East Fork Poplar Creek receive effluent from treated sanitary wastewater, industrial discharges, cooling water blowdown, stormwater, surface water runoff, and groundwater. The chemical water quality of Bear Creek has been affected by the infiltration of contaminated groundwater. Contaminants included high concentrations of dissolved salts, several metals, chlorinated solvents, and polychlorinated biphenyls (PCBs) (OR DOE 1994d:5-9). DOE is currently involved with remediation of East Fork Poplar Creek under CERCLA because the creek was

contaminated by past releases from Y-12. Significant cleanup activities are required onsite and offsite. Contaminants present in East Fork Poplar Creek included mercury, organics, PCBs, and radionuclides (OR DOE 1994d:5-9).

There are 455 NPDES-permitted outfalls associated with the three major facilities at ORR; many of these are stormwater outfalls. Approximately 57,000 NPDES laboratory analyses were completed in 1993, with a compliance rate of over 99 percent. Most excursions were associated with precipitation runoff (OR DOE 1994c:2-13).

As shown in table 4.2.2.4-1, all parameters were below state water quality criteria where the Clinch River leaves ORR. Monitoring data from this sampling site are compared with monitoring data from the Melton Hill Dam sampling site, located upstream of all ORR discharges, and therefore are representative of background water quality. The concentrations downstream of ORR discharges were lower than concentrations upstream in all cases except gross beta and total suspended solids. Concentrations at Melton Hill Dam were also well below applicable water quality criteria.

Table 4.2.2.4-1.-- ***Summary of Surface Water Quality Monitoring of the Clinch River, 1993***

			Average Water Body Concentration	
Parameter	**Unit of Measure**	**Water Quality Criteria**[6]	**Downstream from all DOE Inputs**	**Melton Hill Reservoir Above City of Oak Ridge Water Intake**
Radiological				
Alpha (gross)	pCi/L	15[7]	0.85 (0.30)	1.7 (0.46)
Beta (gross)	pCi/L	50 [8]	4.8 (0.54)	2.9 (0.32)
Cesium-137	pCi/L	120[9]	0.65 (1.2)	NST
Technetium-99	pCi/L	4,000 *d*	2.9 (1.1)	NST
Uranium, Total[10]	pCi/L	20[9]	1.6 (0.97)	1.0 (0.50)
Nonradiological				
Chemical oxygen demand	mg/L	NA	~8.2[11]	15
Fluoride	mg/L	4.0 [7], *2.0*[12]	~0.10 [9]	NST
Manganese	mg/L	0.05[12]	0.036	0.91
Nitrate	mg/L	10.0 [7]	3.3	
pH	pH units	6.5-8.5 [11]	8.0	8.0
Sodium	mg/L	NA	4.1	4.8
Sulfate	mg/L	250 [11]	21.0	22.0
Suspended solids	mg/L	NA	~11.0 [7]	~6.6
Total dissolved solids	mg/L	500[10]	150	170

Surface Water Rights and Permits. In Tennessee, the state's water rights laws are codified in the Water Quality Control Act. In effect, the water rights are similar to riparian rights in that the designated usages of a water body cannot be impaired. The only requirement to withdraw water from available supplies would be a U.S. Army Corps of Engineers permit to construct intake structures.

Groundwater. ORR is located in an area of sedimentary rocks of widely varying hydrological characteristics. However, because of the topographic relief and a decrease in bedrock fracture density with depth, groundwater flow is restricted primarily to shallow depths of the saturated zone in the aquitards, and groundwater discharges primarily to nearby surface waters within ORR (OR DOE 1994c:7-5). Depth to groundwater is generally 6 to 9 m (19.7 to 29.5 ft) but is as little as 1.5 m (4.9 ft) in the area of Bear Creek Valley near Highway 95.

Aquifers at ORR include a surficial soil and regolith unit and bedrock aquifers. The surficial aquifer consists of manmade fill, alluvium, and weathered bedrock. Bedrock aquifers occur in carbonates and low-yield sandstones, siltstones, and shales.

There are no Class I sole-source aquifers that lie beneath ORR. All aquifers are considered Class II aquifers (current potential sources of drinking water). Because of the abundance of surface water and its proximity to the points of use, very little groundwater is used at ORR. Only one water supply well exists on ORR; it provides a supplemental water supply to an aquatics laboratory during extended droughts.

Recharge occurs over most of the area but is most effective where overburdened soils are thin or permeable. In the area near Bear Creek Valley, recharge into the carbonate rocks occurs mainly along Chestnut Ridge (OR DOE 1992c:5-5). Shallow groundwater generally flows from the recharge areas to the center of Bear Creek Valley and discharges into Bear Creek and its tributaries.

Groundwater Quality. Groundwater samples are collected quarterly from a representative number of the more than 1,000 monitoring wells throughout ORR. Groundwater samples collected from the monitoring wells are analyzed for a standard suite of parameters and constituents, including trace metals, volatile organic compounds (VOCs), radioactive materials, and pH. Background groundwater quality at ORR is generally good in the near surface aquifer zones and poor in the bedrock aquifer at depths greater than 300 m (984 ft) due to high total dissolved solids.

Groundwater in Bear Creek Valley near Y-12 has been contaminated by hazardous chemicals and radionuclides (mostly uranium) from past weapons production process activities. The contaminated sources include past waste disposal sites, waste storage tanks, spill sites, and contaminated inactive facilities (OR DOE 1994c:7-11,7-16,7-33-7-36).

Groundwater Availability, Use, and Rights. Industrial and drinking water supplies in the area are primarily taken from surface water sources. However, single-family wells are common in adjacent rural areas not served by the public water supply system. Most of the residential supply wells in the immediate area of ORR are south of the Clinch River (OR DOE 1992c:1-15). Most wells used for potable water are located in the deeper principal carbonate aquifer (305 m [1,000 ft]), while the groundwater contamination at Y-12 is primarily found at a depth of approximately 84 m (276 ft).

Groundwater rights in the State of Tennessee are traditionally associated with the Reasonable Use Doctrine (VDL 1990a:725). Under this doctrine, landowners can withdraw groundwater to the extent

that they must exercise their rights reasonably in relation to the similar rights of others.

4.2.2.5 *Geology and Soils*

Geology. ORR lies in the Valley and Ridge province of east-central Tennessee. The topography consists of alternating valleys and ridges that have a northeast-southwest trend, with most ORR facilities occupying the valleys. Y-12 is in the Bear Creek Valley. Bear Creek Valley and the adjacent Pine and Chestnut Ridges are underlain by rocks composed of siltstone, silty limestone, and shale with some sandstone. The present topography of the valleys is the result of stream erosion of the softer shales and limestones. The ridges are underlain by the more resistant sandstones and dolomites.

ORR is cut by many inactive faults formed during the late Paleozoic Era. The Oak Ridge area lies at the boundary between seismic Zones 1 and 2 (appendix figure A.1-1). Since the New Madrid earthquakes of 1811 to 1812, at least 26 other earthquakes with a modified Mercalli intensity of III to VI have been felt in the Oak Ridge area. Most of these seismic events have occurred in the Valley and Ridge province. The nearest seismic event occurred in 1930, 8 km (5 mi) from ORR. It had a modified Mercalli intensity of V at the site (OR EG&G 1991a: 3-4). The magnitude of the largest recorded earthquake in eastern Tennessee was 4.6 on the Richter scale. This earthquake occurred in 1973 in Maryville, TN, 34 km (21 mi) southeast of ORR, and had an estimated modified Mercalli intensity of V to VI in the Oak Ridge area (DOE 1996h:4.55). There is no volcanic hazard at ORR. The area has not experienced volcanism within the last 230 million years. Therefore, future volcanism is not expected (DOE 1995i:4-200).

Soils. Bear Creek Valley lies on well to moderately well-drained soils underlain by shale, siltstone, and sandstone. Developed portions of the valley are designated as urban land. Soil erosion from past land uses has ranged from slight to severe. Erosion potential is very high in those areas with slopes greater than 25 percent that have been severely eroded in the past. Erosion potential is lowest in nearly flat-lying permeable soils that have a loamy texture (ORNL 1988b:69). Additionally, wind erosion is slight, shrink-swell potential is low to moderate, and the soils are acceptable for standard construction techniques. There are no prime farmlands on ORR (DOE 1995i:4-188).

4.2.2.6 *Biotic Resources*

The following section describes biotic resources at ORR including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. A list of the threatened and endangered species that may be found on or in the vicinity of ORR is presented in appendix C.

Terrestrial Resources. Plant communities at ORR are characteristic of the intermountain regions of central and southern Appalachia. Approximately 10 percent of ORR has been developed since it was withdrawn from public access; the remainder of the site has reverted to or been planted with natural vegetation (OR DOE 1989a:3-5). The vegetation of ORR has been categorized into seven plant communities (figure 4.2.2.6-1). Pine and pine-hardwood forest and oak-hickory forest are the most extensive plant communities on ORR, while northern hardwood forest and hemlock-white pine-hardwood forest are the least common forest community types. Nine-hundred eighty-three species, subspecies, and varieties of plants have been identified on ORR (OR NERP 1993b:2).

Animal species found on ORR include 26 species of amphibians, 33 species of reptiles, 169 species of birds, and 39 species of mammals (OR NERP nda:10-17). Animals commonly found on ORR include the American toad (*Bufo americanus*), eastern garter snake (*Thamnophis sirtalis*), Carolina

chickadee (*Parus carolinensis*), northern cardinal (*Cardinalis cardinalis*), white-footed mouse (*Peromyscus leucopus*), and raccoon (*Procyon lotor*). Although the whitetail deer (*Odocoileus virginianus*) is the only species hunted onsite (OR DOE 1991c:4-6), other game animals are also present. Raptors, such as the northern harrier (*Circus cyaneus*) and great horned owl (*Bubo virginianus*), and carnivores, such as the gray fox (*Urocyon cinereoargenteus*) and mink (*Mustela vison*), are ecologically important groups on ORR. A variety of migratory birds has been found at ORR. Migrating birds present onsite, as well as their nests and eggs, are protected by the *Migratory Bird Treaty Act* .

Terrestrial habitat within the Y-12 area is dominated by buildings, parking lots, and lawns; thus, little natural vegetation is present. A few small forested areas do exist within the plant boundary along the slope of Chestnut Ridge. Fauna within the Y-12 area are limited by the lack of large areas of natural habitat (OR DOE 1994d:5-13).

Wetlands. Wetlands on ORR include emergent, scrub/shrub, forested wetlands associated with embayments of the Melton Hill and Watts Bar Reservoirs, riparian areas bordering major streams and their tributaries, old farm ponds, and groundwater seeps. Well-developed communities of emergent wetland plants in the shallow embayments of the two reservoirs typically intergrade into forested wetland plant communities, which extend upstream through riparian areas associated with streams and their tributaries. Old farm ponds on ORR vary in size and support diverse plant communities and fauna. Although most riparian wetlands on ORR are forested, areas within utility rights-of-way, such as those in Bear Creek and Melton Valleys, support emergent wetland vegetation (OR NERP 1991a:18,26,41). Two small wetland areas are located near the west end of Y-12 (OR DOE 1994d:5-14). Y-12 is drained by Bear Creek and East Fork Poplar Creek; wetlands occur along portions of both streams.

Aquatic Resources. Aquatic habitat on or adjacent to ORR ranges from small, free-flowing streams in undisturbed watersheds to larger streams with altered flow patterns due to dam construction. These aquatic habitats include tailwaters, impoundments, reservoir embayments, and large and small perennial streams. Aquatic areas within ORR also include seasonal and intermittent streams.

Sixty-four fish species have been collected on or adjacent to ORR. The minnow family has the largest number of species and is numerically dominant in most streams (ORNL 1988c:O-43). Fish species representative of the Clinch River in the vicinity of ORR are shad and herring (*Clupeidae*), common carp (*Cyprinus carpio*), catfish (*Ictaluridae*), bluegill (*Lepomis macrochirus*), crappie (*Pomoxis spp* .), and drum (*Aplodinotus grunniens*) (ORNL 1981b:138-139). The most important fish species taken commercially in the ORR area are common carp and catfish. Commercial fishing is permitted on the Clinch River downstream from Melton Hill Dam (TN WRA 1995a:1-5). Recreational species consist of crappie, largemouth bass (*Micropterus salmoides*), sauger (*Stizostedion canadense*), sunfish (*Lepomis spp* .), and catfish. Sport fishing is not permitted within ORR.

Y-12 is drained by Bear Creek and East Fork Poplar Creek. While both streams contain adequate physical habitat to maintain and propagate aquatic life throughout their length, species abundance and diversity within both streams have been affected by past Y-12 operation (OR DOE 1994d:5-13).

Threatened and Endangered Species. Eighty-four Federal- and state-listed threatened, endangered, and other special status species may be found on and in the vicinity of ORR (appendix table C-1). Twenty-six of these species have been identified on the site, 17 of which are Federal- and/or state-listed as threatened or endangered. The bald eagle (*Haliaeetus leucocephalus*) is the only Federal-

listed species observed on the site (i.e., foraging on Melton Hill and Watts Bar Lakes). The additional state-listed species observed include 14 plant, 1 hawk, and 1 salamander species. No critical habitat for threatened or endangered species, as defined in the Endangered Species Act (50 CFR 17.11; 50 CFR 17.12), exists on ORR.

Y-12 does not contain any special status species (OR DOE 1994d:5-14). However, Bear Creek, which drains the western portion of the plant area, contains the Tennessee dace (*Phoxinus tennesseensis*).

4.2.2.7 *Cultural and Paleontological Resources*

Prehistoric Resources. More than 20 cultural resources surveys have been conducted on ORR. About 90 percent of ORR has received at least reconnaissance-level studies; however, less than 5 percent of ORR has been intensively surveyed. Most cultural resources studies have occurred along the Clinch River and adjacent tributaries. Prehistoric sites recorded at ORR include villages, burial mounds, camps, quarries, chipping stations, limited activity locations, and shell scatters. To date, over 45 prehistoric sites have been recorded at ORR, 13 of which may be considered potentially eligible for the NRHP. Most of these sites however have not yet been evaluated.

One site (40RE86), which is located on the Clinch River near K-25, has been determined to be eligible for inclusion on the NRHP. No NRHP-eligible prehistoric sites have been identified at Y-12. One site (40AN6), a lithic scatter, was identified near Scarboro Road east of Y-12, outside the fences. A field review of Y-12 indicated that much of the area had been disturbed and that the potential for NRHP-eligible prehistoric sites was low. Additional prehistoric sites may be identified in the unsurveyed portions of ORR. On May 6, 1994, a Programmatic Agreement concerning the management of historical and cultural properties at ORR was executed among the Oak Ridge Operations Office, the Tennessee State Historic Preservation Officer (SHPO), and the Advisory Council on Historic Preservation. This agreement was administered to satisfy DOE's responsibilities regarding sections 106 and 110 of the National Historic Preservation Act, and requires DOE to develop a cultural resources management plan for ORR and to conduct cultural resources surveys as required.

Historic Resources. Historic resources identified at ORR include both archaeological remains and standing structures. Documented log, wood frame, or fieldstone structures include cabins, barns, churches, gravehouses, springhouses, storage sheds, smokehouses, log cribs, privies, henhouses, and garages. Archaeological remains consist primarily of foundations, roads, and trash scatters. Sixty-nine pre-1942 cemeteries were located within the original ORR site (OR Robinson 1950a:130). Because the size of the reservation has been reduced, today there are 32 known cemeteries within ORR. More than 240 historic resources have been recorded at ORR, and 38 of those sites may be considered potentially NRHP eligible.

All structures at ORR have been surveyed for historic significance, and all pre-World War II structures have been evaluated for NRHP eligibility. Freel's Cabin and two church structures, George Jones Memorial Baptist Church and the New Bethel Baptist Church, are listed on the NRHP. These structures date from before the establishment of the Manhattan Project. NRHP sites associated with the Manhattan Project include the Graphite Reactor at ORNL, listed on the NRHP as a National Historic Landmark, and three traffic checkpoints, Bear Creek Road, Bethel Valley Road, and Oak Ridge Turnpike Checking stations. None of these sites is located at Y-12. Many other buildings and facilities at ORR are associated with the Manhattan Project and may be potentially eligible for the NRHP.

Historic building surveys were completed during fiscal year 1994 at K-25 and ORNL. A similar survey was completed at Y-12 in fiscal year 1995. The final document should be finished in fiscal year 1996. Based on this survey, approximately 100 buildings at Y-12 may be NRHP eligible. The secondary and case fabrication alternative involves modifications to 17 buildings at Y-12 (appendix section A-3.2.1). Through consultation with the Tennessee SHPO, Buildings 9215, 9401-3, 9706-2, 9996, 9998, and 9212 have been determined NRHP eligible as contributing properties to the proposed Y-12 Plant National Register Historic District. In addition, Building 9710-2 has been determined to be NRHP eligible. The remaining buildings involved do not possess architectural or historical significance to meet National Register Criteria and therefore are not considered to be contributing properties to the proposed historic district. Additional historic sites may be anticipated in the unsurveyed portions of ORR.

Native American Resources. The Overhill Cherokee occupied portions of the Tennessee, Hiwassee, Clinch, and Little Tennessee River Valleys by the 1700s. Overhill Cherokee villages consisted of a large townhouse, a summer pavilion, and a plaza. Residences had both summer and winter structures. Subsistence was based on hunting, gathering, and horticulture. Most of the Cherokee people were relocated to the Oklahoma territory in 1838; some Cherokee later returned to the area from Oklahoma. Resources that may be sensitive to Native American groups include remains of prehistoric and historic villages, ceremonial lodges, cemeteries, burials, and traditional plant gathering areas. No Native American resources have been identified at Y-12. The Eastern Band of the Cherokee has been consulted concerning activities at ORR.

Paleontological Resources. The majority of geological units with surface exposures at ORR contain paleontological materials. All paleontological materials consist of invertebrate remains, and these assemblages have relatively low research potential (NRC 1987c:122).

4.2.2.8 *Socioeconomics*

Socioeconomic characteristics addressed at ORR include employment and regional economy, population and housing, and public finance. Statistics for employment and regional economy are presented for the regional economic area that encompasses 15 counties in Tennessee around ORR. Statistics for population and housing, and public finance are presented for the ROI, a four-county area in which 91.3 percent of all ORR employees reside: Anderson County (33.1 percent), Knox County (36 percent), Loudon County (5.6 percent), and Roane County (16.6 percent) (appendix table D.1-1). Figure 4.2.2.8-1 presents a map of the counties and selected cities composing the ORR regional economic area and ROI. Supporting data is presented in appendix D.

Regional Economy Characteristics. Selected employment and regional economy statistics for the ORR regional economic area are summarized in figure 4.2.2.8-2. Between 1980 and 1990, the civilian labor force in the regional economic area increased from 355,353 to 412,803 persons, a 16-percent increase (an annual average increase of 1.6 percent). In 1994, unemployment in the regional economic area was 4.9 percent, about the same as for Tennessee (4.8 percent). The region's per capita income of $17,652 in 1993 was approximately 4.3 percent less than the statewide per capita income of $18,439.

As shown in figure 4.2.2.8-2, the composition of the regional economic area economy parallels that of the statewide economy of Tennessee. During 1993, the service sector constituted over 26 percent of the region's total employment, followed by retail trade (19 percent) and manufacturing (18

percent). For the entire state, the service sector comprised 26 percent of total employment, manufacturing comprised 19 percent, and retail trade, 17 percent.

Population and Housing. Between 1980 and 1992, the ROI population increased from 464,018 to 499,444. This was an increase of about 7.6 percent (an annual average increase of less than 1 percent). Within the ROI, Loudon County experienced the greatest population increase at 16.4 percent (an annual average increase of a little over 0.7 percent), while Roane County's population decreased by about 0.7 percent (much less than 1 percent annually).

Between 1980 and 1990, the total number of housing units in the ROI increased from 181,299 to 206,067. The 13.8-percent increase (1.4-percent annual average increase) in housing units between 1980 and 1990 was slightly less than the annual average increase for the entire state. The total number of housing units in the ROI for 1992 was estimated to be 213,500. The 1990 ROI homeowner and rental vacancy rates were 1.7 and 8.5 percent, respectively. These rates were comparable to the statewide rates. Population and housing trends are summarized in figure 4.2.2.8-3 p.2.

Public Finance. Financial characteristics of the local jurisdictions in the ORR ROI that are most likely to be affected by the proposed action are presented in this section. The data reflect total revenues and expenditures of each jurisdiction's general fund, special revenue funds, and, as applicable, debt service, capital project, and expendable trust funds. Funding for schools in the ROI is provided by the county or city in which they are located. Major revenue and expenditure fund categories for counties and cities are presented in appendix table D.2.3-1. Figure 4.2.2.8-2 summarizes 1994 local governments' revenues and expenditures. Fund balances, which are dollars carried over from previous years, are not included in figure 4.2.2.8-2. All jurisdictions assessed had positive fund balances.

4.2.2.9 *Radiation and Hazardous Chemical Environment*

The following section provides a description of the radiation and hazardous chemical environment at ORR. Also included are discussions of health effects studies, a brief accident history, and emergency preparedness considerations.

Radiation Environment. Major sources of background radiation exposure to individuals in the vicinity of ORR are shown in table 4.2.2.9-1. All annual doses to individuals from background radiation are expected to remain constant over time. Accordingly, the incremental total dose to the population would result only from changes in the size of the population. Background radiation doses are unrelated to ORR operations.

Radionuclides released into the environment from ORR operations provide another source of radiation exposure to individuals in the vicinity of ORR. The radionuclides and quantities released from operations in 1993 are listed in the Oak Ridge Reservation Environmental Report for 1993 (ES/ESH-47). The doses to the public resulting from these releases and direct radiation are presented in table 4.2.2.9-2. These doses fall within radiological limits (DOE Order 5400.5, Radiation Protection of the Public and the Environment) and are small in comparison to background radiation. The releases listed in the 1993 report were used in developing the reference environment (No Action) radiological releases at ORR in 2005 (section 4.2.3.9).

Based on a dose-to-risk conversion factor of 500 cancer deaths per 1 million person-rem ($5x10^{-4}$ fatal cancer per person-rem) to the public (appendix E), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from ORR operations in 1993 is estimated

to be approximately 1.5×10^{-6}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of ORR operations is less than 2 chances in 1 million. (Note that it takes several to many years from the time of exposure to radiation for a cancer to manifest itself.)

Based on the same conversion factor, 0.014 excess fatal cancers are projected in the population living within 80 km (50 mi) of ORR from normal operation in 1993. To place this number in perspective, it can be compared with the numbers of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this national rate, the number of fatal cancers from all causes expected to occur during 1993 was 1,760 for the population living within 80 km (50 mi) of ORR. This number of expected fatal cancers is much higher than the estimated 0.014 fatal cancers that could result from ORR operations in 1993. Workers at ORR receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 4.2.2.9-3 presents the average, maximum, and total occupational doses to ORR workers from operations in 1992. These doses fall within radiological limits (10 CFR 835). Based on a dose-to-risk conversion factor of 400 fatal cancers per 1 million person-rem (4×10^{-4} fatal cancers per person-rem) among workers (appendix E), the number of excess fatal cancers to workers from operations in 1992 is estimated to be 0.027. A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Oak Ridge Reservation Annual Site Environmental Report for 1993* (ES/ESH-47). The concentrations of radioactivity in various environmental media (e.g., air, water, and soil) in the site region (onsite and offsite) are also presented in the same report.

Table 4.2.2.9-1.-- ***Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Oak Ridge Reservation Operations***

Source	Committed Effective Dose Equivalent (mrem/yr)
Natural Background Radiation	
Cosmic and cosmogenic radiation [13]	27
External terrestrial radiation [13]	28
Internal terrestrial radiation [14]	40
Radon in homes (inhaled) [14]	200
Other Background Radiation [14]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	360

Table 4.2.2.9-2.-- ***Doses to the General Public from Normal Operation at Oak Ridge Reservation, 1993 (Committed Effective Dose Equivalent)***

Affected Environment	Atmospheric Releases		Liquid Releases		Total	
	Standard[15]	Actual	Standarda	Actual	Standard[15]	Actual
Maximally exposed individual (mrem)	10	1.4	4	0.6[16]	100	3.0[17]
Population within 80 kilometers[18] (person-rem)	None	26	None	2.0	100	28.0
Average individual within 80 kilometers[19] (mrem)	None	0.030	None	2.3x10 -3	None	0.032

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are presented in previous sections of this PEIS, particularly sections 4.2.2.3 and 4.2.2.4.

Adverse health impacts to the public can be minimized through administrative and design controls to decrease hazardous chemical releases to the environment and achieve compliance with permit requirements (e.g., air emissions and NPDES permit requirements). The effectiveness of these controls is verified by using monitoring information and inspecting mitigation measures. Health impacts to the public may occur during normal operation via inhalation of air containing hazardous chemicals released to the atmosphere by ORR operations. Risks to public health from ingesting contaminated drinking water or direct exposure are also potential pathways.

Baseline air emission concentrations for hazardous air pollutants and their applicable standards are presented in section 4.2.2.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are compared with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in appendix E.

Exposure pathways to ORR workers during normal operation may include inhaling the workplace atmosphere, drinking ORR potable water, and other possible contacts with hazardous materials associated with work assignments. The potential health impacts vary from facility to facility and from worker to worker, and there is not enough information available to allow a meaningful estimation and summation of these impacts. However, workers are protected from workplace-specific hazards through appropriate training, protective equipment, monitoring, and management controls. Workers are also protected by ORR's adherence to OSHA and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals in the workplace. Appropriate monitoring, which reflects the frequency and amounts of chemicals used in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm; therefore, workers' health conditions at ORR are expected to be substantially better than required by the standards.

Table 4.2.2.9-3.-- ***Doses to the Onsite Worker from Normal Operation at Oak Ridge Reservation, 1992***

Affected Environment	Onsite Releases and Direct Radiation Standard[20]	Actual [21]
Average worker (mrem)	None	4.0
Maximally exposed worker (mrem)	5,000	2,000
Total workers (person-rem)	None	68

Health Effects Studies. Two epidemiologic studies were conducted to determine whether or not ORR contributed to any excess cancers in the communities surrounding the facility. One study found no excess cancer mortality in the population living in counties surrounding ORR when compared to the control populations located in other nearby counties and elsewhere in the United States. The other study found a slight increase in several types of cancers in the counties near ORR, but none of the increases were statistically significant.

More epidemiologic studies have been conducted to assess the health effects of the population working at ORR than at any other site reviewed for this PEIS. Increased cancer mortalities have been reported and linked to specific job categories, age, and length of employment, as well as the levels of radiation exposure. For a more detailed description of the studies reviewed and the findings, refer to appendix section E.4.

Accident History. There have been no accidents with a measurable impact on the offsite population during nearly 50 years of Y-12 operation at ORR. The most noteworthy accident in Y-12 history was the 1958 criticality accident. The impact from this accident resulted in radiation sickness for a few ORR employees. In 1989, there was a one-time accidental release of xylene into ORR's sewer system with no adverse offsite impacts. Accidental releases of anhydrous hydrogen fluoride occurred in 1986, 1988, and 1992, with few onsite and negligible offsite impacts. The hydrogen fluoride system where these accidents occurred is being modified to reduce the probability of future releases and to minimize the potential consequences if a release does occur (ORR 1992a:6).

Emergency Preparedness. Each DOE site has established an emergency management program. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

DOE has overall responsibility for emergency planning and operations at ORR; however, DOE has delegated primary authority for event response to the operating contractor. Although the contractor's primary response is onsite, it does provide offsite assistance, if requested, under the terms of existing mutual aid agreements. If a hazardous materials event with offsite impacts occurs at a DOE ORR facility, elected officials and local governments are responsible for the state's response efforts. The Governor's Executive Order No. 4 established the Tennessee Emergency Management Agency as the agency responsible for coordinating state emergency services. When a hazardous materials event occurring at DOE facilities is beyond the capability of local government and assistance is requested, the Tennessee Emergency Management Agency Director may direct state agencies to provide

assistance to the local governments. To accomplish this task and ensure prompt initiation of emergency response actions, the director may activate the State Emergency Operations Center and Field Coordination Center. City or county officials may activate local emergency operations centers in accordance with existing emergency plans.

4.2.2.10 *Waste Management*

This section outlines the major environmental regulatory structure and ongoing waste management activities for ORR. A more detailed discussion of the ongoing waste management operations is provided in appendix section H.2.1.

DOE is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at ORR and is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements and financial penalties for nonachievement of agreed upon milestones. These agreements have been reviewed to assure the proposed actions are allowable under the terms of these agreements.

EPA placed ORR on the National Priorities List (NPL) on November 21, 1989. DOE, EPA Region IV, and the Tennessee Department of Environment and Conservation completed a Federal Facility Agreement effective January 1, 1992, coordinating ORR inactive site assessment and remedial action. Portions of the Federal Facility Agreement are applicable to operating waste management systems. Existing actions being conducted under the *Resource Conservation and Recovery Act (RCRA)* and applicable state laws minimize duplication, expedite response actions, and achieve a comprehensive remediation of the site.

ORR manages a small quantity of spent nuclear fuel and five broad waste categories: TRU, low-level, mixed, hazardous, and nonhazardous. Because there is no spent nuclear fuel or TRU waste associated with any of the proposed activities at ORR, there is no discussion in this PEIS of spent nuclear fuel or TRU waste generation and management at ORR.

Low-Level Waste. LLW generated at Y-12 and K-25 is primarily contaminated with uranium; whereas, at ORNL, LLW consists primarily of mixed fission products. During 1993, Y-12, ORNL, and K-25 generated approximately 1,030 m^3 (272,000 gallon [gal]), 1,540 m^3 (407,000 gal), and 6 m^3 (1,540 gal) of liquid LLW, respectively (OR MMES 1995c:5-12). At Y-12, the Central Pollution Control Facility treats and discharges nonnitrate dilute wastewater, acidic and caustic waste, and plating rinse waters. This facility can also perform pretreatment of nitrate bearing waste streams. The West End Treatment Facility processes nitrate bearing wastewater consisting of nitric acid, nitrate bearing rinse waters, waste coolants, and bio-nitrification sludge. At ORNL, liquid LLW is collected in storage tanks and routed through underground transfer lines to central evaporators for concentration. The concentrate is sent to the Milton Valley storage tanks for storage and the condensate is sent to the Process Waste Treatment Plant for further treatment prior to further management actions.

During 1993, Y-12, ORNL, and K-25 generated approximately 2,400 m^3 (3,130 cubic yards [yd3]), 1,720 m^3 (2,250 yd3), and 1,540 m^3 (2,030 yd3) of solid LLW, respectively (OR MMES 1995c:5-12). Solid LLW consists primarily of radioactively contaminated construction debris, wood, paper, asbestos, trapping media, personal protection equipment, and process equipment. In addition, Y-12,

ORNL, and K-25 also generated 2,335 m^3, 0.3 m^3, and 42 m^3 of contaminated scrap metal, respectively. Depleted and natural uranium machine chips, after oxidation to a stable uranium oxide, are transported to the depleted uranium oxide storage vaults. Uranium sawfines are blended with uranium oxide and placed in the oxide vaults as a short-term storage method. The only LLW disposal facility on ORR is located at ORNL; however, it only accepts LLW generated at ORNL. The declining disposal capacity has created a significant increase in storage requirements. Currently, LLW is shipped to commercial treatment facilities for volume reduction (incineration or supercompaction) or recycle (metal smelting). The resulting residuals are returned to K-25 for storage and shipment to a disposal site.

The management of LLW at ORR has been affected by three recent events: declines in ORR disposal capacity, changes in regulatory and operational conditions, and evolution of the radioactive waste disposal-class concept. The previous strategy classified LLW according to its isotopic content, concentration, and the performance of a disposal facility. In some instances, these classifications are used to describe the type of LLW or a disposal technology. For example, L-I refers to low concentration LLW or a landfill disposal facility, while L-II refers to low-to-moderate concentration LLW or a tumulus disposal facility. A revised classification system has been proposed. Exempt LLW would have contaminant levels sufficiently low to be disposed of in a sanitary or industrial landfill with state concurrence. Disposable LLW would be suitable for disposal at ORR as determined by facility performance assessments. Offsite LLW would be waste which would not meet the criteria of exempt or disposable. The long-range strategy is to rely on the combination of onsite and offsite facilities. Plans for a replacement onsite disposal facility will continue to be pursued with the most likely candidate site for a tumulus disposal facility being Bear Creek Valley. That portion of the LLW that cannot be disposed of onsite consistent with DOE Order 5820.2A, Radioactive Waste Management, will be stored until disposal offsite becomes available.

Mixed Low-Level Waste . RCRA mixed, radioactive land disposal-restricted waste is in storage at Y-12, ORNL, and K-25. Because prolonged storage of these wastes exceeded the 1-year limit imposed by RCRA, ORR entered into a Federal Facility Compliance Agreement for RCRA land disposal restriction wastes with EPA on June 12, 1992. The Federal Facility Compliance Agreement recognizes that DOE will continue to generate and store such mixed wastes subject to land disposal restrictions. A Tennessee Department of Environment and Commissioner's Order was issued on September 26, 1995, that requires DOE to comply with the site treatment plan that was developed pursuant to the Federal Facility Compliance Act of 1992. The plan contains milestones and target dates for DOE to characterize and treat its inventory of mixed wastes.

In 1993, Y-12, ORNL, and K-25 generated 334,016 kilograms (kg) (736,372 pounds [lb]), 176,925 kg (390,049 lb), and 928,948 kg (2,047,959 lb) of mixed LLW, respectively (OR MMES 1995c:7-7). Liquid mixed wastes at Y-12 consist primarily of nonnitrate bearing wastewaters, contaminated groundwaters, nitrate-bearing wastes, cyanide wastes, contaminated waste oils, acidic wastes, caustic wastes, and contaminated solvents. Solid wastes include both RCRA- and TSCA-mixed wastes. The Central Pollution Control Facility and Plating Rinsewater Treatment Facility treat the nonnitrate bearing wastewaters; whereas, the West End Treatment Facility treats nitrate bearing wastes. Other treatment facilities include the Groundwater Treatment Facility, Waste Coolant Processing Facility, Cyanide Treatment Unit, Uranium Treatment Unit, and Biodenitrification Unit.

Mixed waste at K-25 includes liquids, sludges, and soil contaminated with hazardous and PCB constituents (including waste, oils, spent solvents, paints, and cyanide- or sulfide-bearing reactive wastes), and corrosive and toxic wastes from laboratory processes. Treatment facilities at K-25

include the Central Neutralization Facility and the TSCA Incinerator. The primary waste streams treated at the Central Neutralization Facility include the scrubber effluent from the TSCA Incinerator and process wastewaters from the K-1501 Steam Plant. The K-25 TSCA incinerator has a design capacity to incinerate 907 kg/hour (hr) (2,000 lb/hr) of mixed liquid waste and up to 454 kg/hr (1,000 lb/hr) of solids and sludge (91 kg/hr [200 lb/hr] maximum sludge content). The TSCA incinerator is capable of incinerating both TSCA- and RCRA-mixed waste. DOE guidance currently does not allow incineration of solids or sludges. Because of permit limits (i.e., TSCA, RCRA, and the State of Tennessee), the incinerator is not running at full capacity. In 1993, approximately 2,309 m *3* (610,000 gal) of mixed liquid waste was incinerated (OR MMES 1995c:7-9).

ORNL has no facilities specifically designed for the treatment of mixed wastes. Generators currently neutralize many corrosives before discharge to process drains. Organic mixed wastes are scheduled to be treated at the TSCA Incinerator.

Uranium-contaminated PCB wastes (mixed wastes) are being stored in excess of the 1-year limit imposed by TSCA because of the lack of treatment and disposal capacities. DOE and EPA have signed a Federal Facility Compliance Agreement, effective February 20, 1992, to bring the K-25 site associated with the Uranium Enrichment Program into compliance with TSCA regulations for use, storage, and disposal of PCBs. It also addressed the approximately 10,000 pieces of nonradioactive PCB-containing dielectric equipment associated with the shutdown of diffusion plant operations. An additional Federal Facility Compliance Agreement related to TSCA compliance is currently being discussed by DOE and EPA for ORR.

Hazardous Waste. RCRA-regulated wastes are generated by ORR in laboratory research, electroplating operations, painting operations, descaling, demineralizer regeneration, and photographic processes. Certain other wastes (e.g., spent photographic processing solutions) are processed onsite into a nonhazardous state. Those wastes that are safe to transport and are certified as having no radioactivity added are shipped offsite to RCRA-permitted commercial treatment or disposal facilities. Small amounts of reactive chemical explosives that would be dangerous to transport offsite, such as aged picric acid, are processed onsite in the Chemical Detonation Facility at ORNL.

Y-12 generated approximately 9,920 m^3 (13,000 yd3) of hazardous waste in 1993 (OR MMES 1995c:6-4). Of this amount approximately 8,840 m^3 (11,600 yd3) was liquid hazardous waste that was managed as mixed LLW and treated at the Plating Rinsewater Treatment Facility and the Steam Plant Wastewater Treatment Facility. The solid waste was treated offsite. Liquid and solid hazardous waste streams include steam plant wastewaters for treatment, mineral oil contaminated with PCBs, and sludges. All hazardous waste generated at K-25, including all wastes subject to RCRA and TSCA regulations, is managed as mixed LLW.

At ORNL approximately 23,800 m^3 (31,200 yd3) of liquid hazardous waste was generated in 1993. Bulk nonnitrate acids previously neutralized at the Nonradiological Wastewater Treatment Plant are now sent to the Central Neutralization Facility. No treatment is performed for the approximately 354 m^3 (464 yd3) of solid hazardous waste at ORNL (OR MMES 1995c:6-5). Some waste is sent to K-25 for storage or incineration, while the remainder (non-RCRA) is sent to a landfill at Y-12. Hazardous waste at K-25 is managed as mixed waste. Hazardous waste is collected and stored until it can be certified under the "no rad added" policy, at which time it is shipped offsite.

Nonhazardous Waste. Nonhazardous wastes are generated from ORR maintenance and utilities. For example, the steam plant produces a nonhazardous sludge. Scrap metals are discarded from maintenance and renovation activities and are recycled, when appropriate. Construction and demolition projects also produce nonhazardous industrial wastes. All nonradioactive medical wastes are autoclaved to render them noninfectious and are sent to the Y-12 sanitary landfill. Remedial action projects also produce wastes requiring proper management. The State of Tennessee-permitted landfill (Construction Demolition Landfill VI) receives nonhazardous industrial materials such as fly ash and construction debris. Asbestos and general refuse are managed in the Industrial and Sanitary Landfill V located at Y-12.

Approximately 52,800 m^3 (69,100 yd3) of solid industrial and sanitary wastes were generated on ORR in 1993 (OR MMES 1995c:8-4). Y-12 is the single largest generator of this waste category with 43,900 m^3 (57,600 yd3). ORNL and K-25 generated approximately 11 and 6 percent, respectively, of the total nonhazardous waste.

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1 Federal standard.

2 Value is maximum for 24-hour period.

3 No monitoring data available, baseline concentration assumed less than applicable standard.

4 State standard.

5 Annual average. *f* No standard. 40 CFR 50; OR DOE 1993a; TN DEC 1994a; TN DHE 1991a.

6 For comparison only.

7 National Primary Drinking Water Regulations (40 CFR 141).

8 Proposed National Primary Drinking Water Regulations, Radionuclides (56 FR 33050).

9 DOE Derived Concentration Guides for water (DOE Order 5400.5). Values are based on a committed effective dose equivalent of 100 millirems (mrem) per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the Derived Concentration Guides.

10 Minimum of uranium isotopes.

11 A tilde (~) indicates that estimated values and/or detection limits were used in the calculation.

12 National Secondary Drinking Water Regulations (40 CFR 143).
NA - not applicable; NST - no sample taken; parentheses () indicate standard error of the mean.
OR DOE 1994f.

13 OR DOE 1994c.

14 NCRP 1987a. Value for radon is an average for the United States.

15 The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem per year limit from airborne emissions is required by the CAA, the 4 mrem per year limit is required by the *SDWA* , and the total dose of 100 mrem per year is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (58 FR 16268).

16 Includes a dose of 0.20 mrem from drinking water.

17 Includes an annual direct radiation dose of 1 mrem to an individual at Poplar Creek or the Clinch River shoreline.

18 In 1993, this population was approximately 880,000.

19 Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.
OR DOE 1994c..

20 10 CFR 835. DOE's goal is to maintain radiological exposure as low as reasonably achievable.

21 DOE 1993n:7. The number of badged workers in 1992 was approximately 17,000.

4.5 Pantex Plant

Pantex was established in 1951 and currently occupies approximately 4,119 ha (10,177 acres) of DOE-owned land near Amarillo, TX. The current DP mission at Pantex is to assemble and disassemble nuclear weapons; perform HE manufacturing; perform weapons repair, modification, and disposal; conduct stockpile evaluation and testing; and provide interim storage for plutonium. Section 3.2.5 provides a description of all the DOE missions and support facilities at Pantex. The location of Pantex is illustrated in figure 4.5-1, and the principal facilities and zones at Pantex are shown in figure 4.5-2.

4.5.1 Description of Alternatives

No Action. Pantex would continue to perform the missions described in section 3.2.5.

Stockpile Management Alternatives. The A/D and the high explosives (HE) fabrication missions could be downsized and consolidated and remain at Pantex. If the A/D mission remains at Pantex, the nonintrusive modification pit reuse mission and the option of storing the strategic reserve of pits could be located there. In addition, if Y-12 does not retain the secondary and case fabrication mission, the storage of the strategic reserve of secondaries could be located at Pantex.

The HE fabrication mission could be phased out at Pantex and transferred to either LANL, LLNL, or both. In the event that the HE fabrication mission was transferred, those facilities associated with this mission would be phased out and Pantex downsized to accommodate just the A/D mission. The nonintrusive modification pit reuse and strategic storage options would also be located at Pantex.

The A/D mission could either stay at Pantex without the HE fabrication mission or it could be phased out at Pantex and transferred to NTS. If the A/D mission was also transferred, then all of the DP missions at Pantex would be phased out and the entire plant could be turned over to EM for disposition.

Stockpile Stewardship Alternatives. There are no stockpile stewardship alternatives that include Pantex.

4.5.2 Affected Environment

4.5.2.1 *Land Resources*

Pantex is located within Carson County in the Panhandle region of Texas, 27 km (17 mi) east-northeast of downtown Amarillo. Pantex covers 6,466 ha (15,978 acres) of land, of which 4,119 ha (10,177 acres) are owned by the Federal Government, and 2,347 ha (5,800 acres) immediately south of the main plant area are leased from Texas Tech for use as a safety and security buffer zone. DOE-owned land at the plant facility includes 3,683 ha (9,100 acres) in the main plant area and 436 ha (1,077 acres) around Pantex Lake, 4 km (2.5 mi) northeast of the main plant area. The undeveloped land at Pantex Lake is held by DOE to retain water rights. All owned and leased buildings on the Pantex site are administered, managed, and controlled by DOE. Generalized land uses at Pantex and in the vicinity are shown in figure 4.5.2.1-1.

Industrial operations at Pantex are currently located on approximately 809 ha (2,000 acres) of DOE-

owned property, excluding the Burning Ground, firing sites, and other outlying areas. The Burning Ground and firing sites occupy approximately 198 ha (489 acres).

Texas Tech Agriculture Research operations use DOE-leased land that is not actively used by Pantex operations for agricultural use. Agricultural activities generally consist of dry farming and livestock grazing. A limited amount of crop irrigation occurs. Except for the playas, the Natural Resources Conservation Service (formerly the Soil Conservation Service) considers these lands prime farmland when irrigated. Texas Tech land also contains four dwelling units located approximately 5 km (3 mi) southwest of the weapons A/D and HE production core.

The land surrounding Pantex is rural private property. The closest offsite residences are approximately 31 m (102 ft) west of the plant boundary along Farm-to-Market Road 683. Most of the surrounding land is prime farmland when irrigated, with the exception of the area northwest of the plant site, which is rangeland. The majority of the surrounding land is cultivated. The packing plant of Iowa Beef Packers, Inc., is the only industrial facility within 3 km (2 mi) of the plant.

Four low-altitude Federal airways used by the Amarillo International Airport for aircraft landings and takeoffs cross or come near Pantex. The runway is located approximately 11 km (7 mi) southwest of the site boundary.

It is anticipated that future residential development in the area will occur toward the southwest, away from the plant. The East Planning Area of the city, which extends to within 3.2 km (2 mi) of the plant site, has historically been one of the slower growing residential areas. Because of the presence of the airport, an important industrial use in this area, the Amarillo Comprehensive Plan encourages compatible use rather than residential use. The largest residential area, located approximately 8 km (5 mi) southwest of the plant boundary, is the site of the former Amarillo Air Force Base housing, which has been converted to rental housing.

Table 4.5.2.2-1.-- ***Baseline Characteristics for Pantex Plant***

Characteristics	Current Value
Land	
Area (ha)	4,119
Roads (km)	76
Railroads (km)	27
Electrical	
Energy consumption[1] (MWh/yr)	84,420
Peak load (MWe)[2]	13.6
Fuel	
Natural gas[3] (m^3/yr)	14,600,000
Liquid (L/yr)	1,775,720
Coal (t/yr)	0
Steam[4]	
Generation (kg/hr)	59,524

4.5.2.2 *Site Infrastructure*

Section 3.2.5 describes the current missions at Pantex. To support these missions, infrastructure exists as shown in table 4.5.2.2-1.

4.5.2.3 *Air Quality*

This section describes existing air quality including a review of the meteorology and climatology in the vicinity of Pantex. More detailed discussions of the air quality methodologies, input data, and atmospheric dispersion characteristics are presented in appendix section B.3.5.

Meteorology and Climatology. The climate at Pantex and in the surrounding region is characterized as semi-arid with hot summers and relatively cold winters. The average annual temperature in the Amarillo region is 13.8 °C (56.9 °F); average daily temperatures vary from a mean daily minimum of -5.7 °C (21.8 °F) in January to a mean daily maximum of 32.8 °C (91.1 °F) in July. The annual average precipitation is approximately 49.7 cm (19.6 in). Prevailing wind directions at Pantex are from the south to southwest. The annual average wind speed is 6.0 m/s (13.5 mph) (NOAA 1994c:3).

Ambient Air Quality. Pantex is located within the Amarillo-Lubbock Intrastate AQCR 211, which is currently designated as "attainment" or "unclassified" by EPA (40 CFR 81.344) with respect to the NAAQS for criteria pollutants (40 CFR 50). Appendix table B.3.1-1 lists the NAAQS for these criteria pollutants. These standards have been adopted by the State of Texas (TX ACB 1993a). There are no Prevention of Significant Deterioration (40 CFR 52.21) Class I areas within 100 km (62.1 mi) of Pantex.

The primary emission sources of criteria pollutants at Pantex are the steam plant boilers, the explosives burning operation, and diesel and gasoline engines. Potential emission sources of hazardous/toxic air pollutants include the HE Synthesis Facility, the explosives burning operation, miscellaneous laboratories, and other small operations. With the exception of open burning of HE at the Burning Ground, most stationary points of nonradioactive atmospheric releases are from fume hoods and building exhaust systems with HEPA filters.

Table 4.5.2.3-1 presents the baseline ambient air concentrations for criteria pollutants and other pollutants of concern at Pantex. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Table 4.5.2.3-1.-- ***Comparison of Baseline Ambient Air Concentrations wiTD Most Stringent Applicable Regulations and Guidelines at Pantex Plant, 1993***

Pollutant	Averaging Time	Most Stringent Regulation or Guideline (g/m^3)	Baseline Concentration (g/m^3)
Criteria Pollutant			
Carbon monoxide	8-hour	10,000[5]	161

	1-hour	40,000[5]	924
Lead	Calendar quarter	1.5[5]	0.01
Nitrogen dioxide	Annual	100[5]	0.90
Ozone	1-hour	235[5]	[6]
Particulate matter	Annual	50[5]	8.73
	24-hour	150[5]	88.5
Sulfur dioxide	Annual	80[5]	<0.01
	24-hour	365[5]	<0.01
	3-hour	1,300[5]	<0.01
	30-minute	1,045[7]	<0.01
Mandated by Texas			
Hydrogen fluoride	30-day	0.8[7]	<0.27
	7-day	1.6[7]	<0.27
	12-hour	2.9[7]	0.27
	24-hour	3.7[7]	0.38
	3-hour	4.9[7]	1.52
Hydrogen sulfide	30-minute	111[7]	[6]
Sulfuric acid	24-hour	15[7]	[6]
	1-hour	50[7]	[6]
Total suspended particulates	3-hour	200[7]	[6]
	1-hour	400[7]	[6]
Hazardous and Other Toxic Compounds			
Alcohols	30-minute[8]	100[7]	195
	Annual	[9]	0.70
Benzene	30-minute[8]	30[7]	19.40
	Annual	3[7]	0.05
Carbon disulfide	30-minute[8]	30[7]	22.60

	Annual	3[7]	0.09
Carbon tetrachloride	30-minute[8]	126[7]	19.7
	Annual	13[7]	0.08
Chlorobenzene	30-minute[8]	460[7]	19.5
	Annual	46[7]	0.08
1,1,1-ChloroeTDane	30-minute[8]	500[7]	127
	Annual	50[7]	0.53
Chromium	30-minute[8]	1[7]	0.10
	Annual	0.1[7]	0.002
Cresol	30-minute[8]	5[7]	0.41
	Annual	[9]	0.002
Cresylic acid	30-minute[8]	5[7]	0.51
	Annual	[9]	0.002
Dibenzofuran	30-minute[8]	[9]	0.001
	Annual	[9]	0.00002
Ester glycol eTDers	30-minute[8]	[9]	35.9
	Annual	[9]	0.15
ETDyl benzene	30-minute[8]	2,000[9]	31.1
	Annual	434[7]	0.13
ETDylene dichloride	30-minute[8]	40[7]	9.58
	Annual	4[7]	0.04
Formaldehyde	30-minute[8]	15[7]	0.37
	Annual	1.5[7]	0.004
Hydrogen chloride	30-minute[8]	75[7]	5.98
	Annual	0.1[7]	0.09
Ketones	30-minute[8]	[9]	33.4
	Annual	[9]	0.14
Mercury	30-minute[8]	0.5[7]	0

	Annual	0.05[7]	0
MeTDanol	30-minute[8]	[9]	245
	Annual	[9]	0.58
MeTDyl cyanide	30-minute[8]	[9]	0
	Annual	[9]	0
MeTDyl eTDyl ketone	30-minute[8]	3,900[7]	1,400
	Annual	590[7]	5.10
MeTDyl isobutyl ketone	30-minute[8]	2,050[7]	4.45
	Annual	205[7]	0.02
MeTDylene chloride	30-minute[8]	260[7]	180
	Annual	26[7]	0.74
NaphTDalene	30-minute[8]	440[7]	0.005
	Annual	50[7]	0.0001
2-Nitropropane	30-minute[8]	50[7]	8.55
	Annual	5[7]	0.04
Nitrobenzene	30-minute[8]	24[7]	0.51
	Annual	5[7]	0.002
Phenol	30-minute[8]	154[7]	0.03
	Annual	19[7]	0.0006
TetrachloroeTDylene	30-minute[8]	340[7]	17.6
	Annual	34[7]	0.07
Toluene	30-minute[8]	1880[7]	568
	Annual	188[7]	1.73
1,1,2-TrichloroeTDane	30-minute[8]	550[7]	17.3
	Annual	55[7]	0.08
TrichloroeTDylene	30-minute[8]	*1350*[7]	51.1
	Annual	135[7]	0.21
TrieTDylamine	30-minute[8]	40[7]	1.08

	Annual	4[7]	0.002
Xylene	30-minute[8]	3700[7]	145
	Annual	434[7]	0.47

4.5.2.4 *Water Resources*

This section describes the surface and groundwater resources at Pantex.

Surface Water. There are no streams or rivers at Pantex, and all site water requirements are currently met by groundwater. All surface water drains to playas, natural closed depressions that collect runoff to form ephemeral lakes. There are six playas associated with Pantex. Playas 1 through 3 are located on the main site, Playas 4 and 5 are located south and southwest, respectively, of the main site, and Pantex Lake (the sixth playa) is located approximately 4 km (2.5 mi) northeast of the main site (figure 4.5.2.4-1).

Playa 1 receives continuous wastewater discharges from the Pantex Wastewater Treatment Facility. Treated industrial wastewater discharges from buildings, and stormwater runoff are directed to Playas 1, 2, and 4. Playa 3 receives stormwater runoff from the Pantex Burning Ground. Playa 5 has received wastewater from numerous sources other than Pantex. Past Pantex activities included discharge of treated effluents to Pantex Lake. There are also a number of playas adjacent to Pantex that receive drainage from perimeter portions of the site. Playas provide a source of groundwater recharge through infiltration, although the rate of recharge is unknown. A study to determine this infiltration rate is currently being conducted (PX DOE 1996b:4-55).

Because there are no onsite or nearby flowing streams, floodplains exist only in association with the playas. The U.S. Army Corps of Engineers delineated 100- and 500-year floodplains and concluded that the only incidence of flooding would occur at Playa 3. The 500-year flood runoff at Playa 3 would overflow out of the drainage basin creating shallow (less than 30 cm [1 ft]) flooding of the drainage basins for Playas 1 and 2. This limited flooding would not affect the operations of Pantex (PX DOE 1996b:4-57).

Surface Water Quality. Surface water monitoring is conducted at all five playas at the main plant and Pantex Lake as well as at Bushland Playa, an offsite control playa (50 km [30 mi] west of Pantex) used for comparative purposes. Bushland Playa was dry during 1994. With the exception of a June 1994 high water level in Playa 1, due to a rainfall event, the Texas Natural Resources Conservation Commission's annual wastewater inspection in 1993 and 1994 did not note any deficiencies with permit requirements; however, the plant reported 16 excursions of the pH limitation during 1993. A treatment to adjust the effluent pH was installed in September 1993.

Surface Water Rights and Permits. Pantex submitted an NPDES permit application for industrial discharge on November 5, 1990, and a stormwater discharge permit application in October 1991. EPA classified the playa lakes as jurisdictional wetlands and not "waters of the U.S." and therefore did not issue either permit. EPA requested on February 16, 1994, that Pantex resubmit modified NPDES permit applications for industrial discharge to Playas 1, 2, and 4. The application was submitted to EPA on August 26, 1994. A Notice of Intent to discharge stormwaters associated with nonconstruction industrial activities into Playas 1, 2, 3, and 4 via outfalls 007 through 030 was submitted to EPA on September 30, 1994. A stormwater permit was issued by EPA in February 1995.

A draft NPDES industrial discharge permit was issued on December 31, 1994. Comments followed the issuance of the permit, and additional information was requested. A revised draft NPDES permit was issued on August 12, 1995; issuance of a final permit is still pending (PX DOE 1996b:4-61).

Treated domestic and industrial wastewater from Pantex is discharged into Playas 1 and 2 under the Texas Natural Resource Conservation Commission Wastewater No-Discharge Permit No. 02296. This permit was issued on May 19, 1980, and renewed and modified on May 3, 1988. This permit allows wastewater disposal by evaporation and onsite irrigation on Texas Tech University farmland. A modified renewal application was submitted on December 26, 1990. This application was protested, and the existing permit expired on May 6, 1993, without renewal. A settlement was reached on November 6, 1995, between Pantex and the local citizens. Issuance of the final permit is still pending. Until a decision is made by the Texas Natural Resource Conservation Commission, the plant continues to operate under the terms and conditions of the expired permit (PX DOE 1996b:4-61).

Water rights in Texas fall under the Doctrine of Prior Appropriations. Under this doctrine, the user who first appropriated water for a beneficial use has priority to use available water supply over a user claiming rights at a later time. Courts also recognize riparian rights legally granted from Spanish-American Agreements. The Texas Natural Resources Conservation Commission is the administrator for water rights and is the permit-issuing authority.

Groundwater. Pantex is located on the Texas High Plains aquifer system, which is the southernmost extension of a regional aquifer that extends from Texas to South Dakota (PX WDB 1993a:1). The two principal water-bearing units beneath Pantex and adjacent areas are the Ogallala aquifer and the underlying Dockum Group aquifer (PX DOE 1983a). Deep wells in the northeast corner of Pantex, completed at depths of 183 to 259 m (600 to 850 ft) into the Ogallala Formation, have provided the water supply at Pantex for over 40 years. A discontinuous perched aquifer is present at 66 to 88 m (217 to 290 ft) below ground surface; it is best defined under the eastern portion of Pantex, particularly under Zones 11 and 12. The perched groundwater is capable of yielding 2 to 5 gallons per minute, but is not used as a source for drinking water for any plant operations (PX DOE 1996b:4-65).

The Ogallala aquifer beneath Pantex has not been classified by EPA; however, it is the only source of drinking water at Pantex. Depth to water in the Ogallala aquifer ranges from 104 m (341 ft) at the southern boundary of Pantex to 140 m (459 ft) at the northern boundary. The saturated thickness of the Ogallala Formation ranges from 15 m (49.2 ft) to more than 120 m (394 ft) and in some areas is capable of producing yields in excess of 4,000 L per minute (1,050 gal per minute). Estimates of annual recharge rates to the Ogallala aquifer vary from 0.02 to 4.1 cm/yr (0.0079 to 1.6 in/yr) (PX DOE 1996b:4-69) based on earlier studies that investigated slow regional infiltration of precipitation and recent studies that explored percolation of water through playa lakes and leakage from the Dockum Group aquifer into the Ogallala aquifer (PX WDB 1993a:2).

The withdrawal of water from the Ogallala aquifer continues to exceed recharge, causing water levels to decline in the Pantex area at a rate of approximately 0.6 to 2 m/yr (1.97 to 6.56 ft/yr). From 1980 to 1990, the city of Amarillo well field north of Pantex experienced up to 20 m (60 ft) of water-level decline, causing a depression in the groundwater surface northeast of Pantex (PX WDB 1993a:11). In 1990, the recoverable volume of water in storage and available for use in the Ogallala aquifer was estimated at 5.15×10^{14} L (1.36×10^{14} gal) (PX DOE 1996b:4-71). Figure 4.5.2.4-1 shows the groundwater surface of the Ogallala aquifer beneath Pantex.

Groundwater Quality. Pantex's groundwater monitoring program includes monitoring wells and onsite Ogallala production wells distributed throughout the facility. Wells located in the vicinity of the plant are shown in figure 4.5.2.4-1. Groundwater samples collected from the wells are analyzed for a standard suite of parameters and constituents, including volatile organics, semi-volatile organics, pesticides, herbicides, trace metals, radionuclides (gross alpha and gross beta), and field parameters (total dissolved solids and pH). Limited metal concentrations have been found in some of the groundwater samples from the wells monitoring the Ogallala aquifer, including iron which was above the drinking water regulation.

Table 4.5.2.4-1 shows the most recent groundwater analytical data from the Ogallala aquifer. Past groundwater samples from the perched zone have been found to contain a variety of constituents that are either above background levels or drinking water standards or are not naturally occurring. These include 1,2-dichloroethane; chromium; iron; total dissolved solids; and trichloroethane. Table 4.5.2.4-2 shows the groundwater quality from three wells completed in the perched zone.

Groundwater Availability, Use, and Rights. Five production wells in the northeast corner of Pantex serve the plant's industrial and potable water needs. During the 1994 water year, the plant pumped 836 million L (221 million gal) of water from the Ogallala aquifer, while the city of Amarillo pumped 23,900 million L (6,320 million gal) from its Carson County well field located immediately north and northeast of the plant (PX DOE 1996b:4-77). The capacity of Pantex well field is approximately 1,990 MLY (526 MGY). Pantex Lake, located adjacent to the Amarillo water-well field, is available for drilling additional water wells if needed for future Pantex operations.

Groundwater is controlled by the individual landowner in Texas. The Texas Department of Health and the Texas Water Development Board are the two state agencies with major involvement in groundwater fact finding, data gathering, and analysis. Local groundwater management is the responsibility of local jurisdictions through Groundwater Management Districts. The Pantex facility is located in Panhandle Groundwater District 3, which has the authority to require permits and limit the quantity of water pumped. Presently, the Panhandle Groundwater District does not limit the quantity of water pumped.

Table 4.5.2.4-1.-- ***Groundwater Quality Monitoring of TDe Ogallala Aquifer Wells at Pantex Plant, 1994***

Parameter	Unit of Measure	Water Quality Criteria and Standards[10]	Well Number OM-39	Well Number OM-40
Radiological				
Alpha (gross)	pCi/L	15 [11]	<MDA-1.0	<MDA-1.0
Beta (gross)	pCi/L	50 [12]	<MDA-1.0 (0.8)	<MDA-1.0
Tritium	pCi/L	80,000 [13]	<MDA-50	<MDA-100

				(70)
Uranium -234	pCi/L	20 [12]	0.8-5.5	3.5-5.3
			(1.1)	(0.5)
Uranium -238	pCi/L	24 [12]	0.9-2.7	2-2.7
			(0.4)	(0.2)
Nonradiological				
Barium	mg/L	2 .0[11]	0.12-0.19	0.14-0.17
Chromium	mg/L	0.1[11]	0.005	<0.005-0.007
Copper	mg/L	1.0[14]	<0.005	<0.005-0.01
1,2-DichloroeTDane	mg/L	0.005[11]	<0.005	<0.005
HMX	mg/L	NA	<0.020	<0.020
Iron	mg/L	0 .3[14]	0.06-1.49	0.15-0.28
Lead	mg/L	0 .015[11]	<0.005	<0.005
Nitrate	mg/L	10 [11]	0.77-2.19	1.24-1.77
pH	pH units	6 .5-8.5[14]	7.2-7.6	6.7-7.5
RDX	mg/L	NA	<0.020	<0.020
Sulfate	mg/L	250 [14]	16-26	18-22
Total dissolved solids	mg/L	500 [14]	210-310	220-360
Total organic carbons	mg/L	NA	<1.0-1	<1-2
Total organic halogens	mg/L	NA	<3-23	<3-6
TrichloroeTDylene	mg/L	0 .005[11]	<0.005	<0.005
Zinc	mg/L	5 [14]	0.221-1.9	0.033-0.048

Table 4.5.2.4-2.-- ***Groundwater Quality Monitoring of TDe Perched Zone Wells at Pantex Plant, 1994***

Parameter	Unit of Measure	Water Quality Criteria and Standards[15]	Well Number PM-44	Well Number PM-45	Well Number PM-20
Radiological					
Alpha (gross)	pCi/L	15 [16]	<MDA	<MDA-1	<MDA-1
Beta (gross)	pCi/L	50 [17]	<MDA-3	<MDA-2	<MDA-1 (0.8)
Tritium	pCi/L	80,000 [18]	<MDA-100	<MDA-40 (350)	<MDA-160 (900)
Uranium-234	pCi/L	20 [18]	1.8-2.8 (0.3)	4.3-5.5 (0.4)	2.6-3.8 (0.3)
Uranium-238	pCi/L	24[18]	0.81-1.7 (0.2)	2.2-3 (0.3)	1.5-2.3 (0.2)
Nonradiological					
Barium	mg/L	2 [16]	0.13-0.15	0.22-0.25	0.16-0.23
Chromium	mg/L	0 .1[16]	<0.005-0.007	<0.005-0.01	0.53-1.95
Copper	mg/L	1 .0[19]	<0.005-0.006	<0.005-0.005	<0.005-0.006
1,2-DichloroeTDane	mg/L	0 .005[16]	<0.005	<0.005	<0.005
HMX	mg/L	NA	<0.020	<0.020	<0.020-0.07
Iron	mg/L	0 .3[19]	0.01-0.09	0.02-0.08	0.2-3.55
Lead	mg/L	0 .015[16]	<0.005	<0.005	<0.005
Nitrate	mg/L	10 [16]	<0.01-4.12	1.02-3.19	1.5-4.8
pH	pH units	6 .5-8.5[19]	7.3-7.6	6.9-7.3	7.2-7.9
RDX	mg/L	NA	<0.020	<0.020	<0.020-1.1
Sulfate	mg/L	250 [19]	12	25-28	24-40

Total dissolved solids	mg/L	500 [19]	180-230	370-460	280-500
Total organic carbons	mg/L	NA	<1-2	<1-3	<1-1
Total organic halogens	mg/L	NA	<5-8	6-13	69-95
TrichloroeTDane	mg/L	0 .2 [16]	<0.005	<0.005-0.01	<0.005-0.15
Zinc	mg/L	5 [19]	0.011-0.038	0.006-0.032	<0.005-0.017

4.5.2.5 ***Geology and Soils***

Geology. Pantex is located on the southern High Plains of the Texas panhandle. The topography at Pantex consists of flat to gently rolling plains. There are no unique landforms, and the only distinctive features are playas that are spaced more or less uniformly over the site. The playas are about 500 to 1,000 m (1,640 to 3,280 ft) across with clay bottoms and depths to 9 m (30 ft).

The site itself is underlain by the Blackwater Draw Formation. At Pantex this geologic formation consists of a sequence of buried soils with an upper unit of mostly silt, clay, and caliche and a 12- to 23-m (40- to 75-ft) thick lower unit of silty sand with caliche. The Ogallala Formation, one of two principal water-bearing units beneath Pantex and adjacent areas, underlies the Blackwater Draw Formation.

The plant is located at the edge of a large Permian fault block, but there is no indication of faulting in the immediate area in the last 250 million years. Pantex lies on the boundary between seismic Zones 0 and 1 (figure A.1-1). Since 1906, only nine earthquakes of Richter magnitude 3.0 or greater have been recorded in the more seismically active Amarillo Uplift region 20 km (12 mi) northeast of Pantex. Seismicity in the Palo Duro Basin and at Pantex is low. There is no volcanic hazard at Pantex (DOE 1995i:4-298).

In the High Plains area, salt dissolution in Permian formations is an active process which can lead to sinkholes and fractures. Such surficial expressions have not been identified in Carson County, where Pantex is located. Sinkholes and fractures have been identified, however, in adjacent Armstrong County to the south and Hutchinson County to the north (PX DOE 1996b:4-29, 4-31).

Soils. Pantex is underlain by soils of the Pullman-Randall association. These soils are typically deep, very low permeability clay loams and clays. Pullman soils underlie most of the plant area, but Randall soils occur in the vicinity of the playas and depressions. Areas of Estacado, Lofton, and Pep clay loams are found in sloping areas surrounding playa bottoms (PX DOE 1995d:5-3). Water and wind erosion and shrink-swell potential are moderate to severe for most of the soil units (PX USDA 1962a:1,2; PX USDA 1980a:31,32). However, the soils are acceptable for standard construction techniques. DOE-leased land at Pantex that is used for agricultural purposes by Texas Tech is considered prime farmland when irrigated (DOE 1995i:4-282).

4.5.2.6 ***Biotic Resources***

The following section describes biotic resources at Pantex including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. A list of threatened and endangered species that may be found on or in the vicinity of Pantex is presented in appendix C.

Terrestrial Resources. Pantex is located within a treeless portion of the High Plains that is classified as mixed prairie. The primary vegetation of the High Plains includes short-grasses (buffalo-grass [Buchloe dactyloides] and blue grama [Bouteloua gracilis]) and mid-grasses (little bluestem [Schizachyrium scoparium], sideoats grama [Bouteloua curtipendula], and western wheatgrass [Agropyron smithii]) (PX DOE 1991a:2). Approximately 23 percent of the site, including land leased from Texas Tech University, has been developed. Much of the remainder of the site has been disturbed by past agricultural practices and is being managed as native and improved pasture, or is being cultivated by the university or its tenant farmers (PX DOE 1983a:3-20,3-23). Small areas of relatively undisturbed vegetation exist around playas. Some protection for native habitat is also provided at Pantex where plant operations preclude agricultural activities. Vegetation within these areas consists primarily of grasses and herbs, although barrel cactus *(Ferocactus sp.)* is also present (PX DOE 1995d;5-3, 5-4). Plant communities on the site have not been mapped. A total of 229 plant species has been identified at Pantex (PX DOE 1993c:2).

Terrestrial wildlife species identified on Pantex include 7 amphibians, 8 reptiles, 43 birds, and 19 mammals (PX DOE 1994c:4-5; PX DOE 1994d:7-11). Common animal species known to exist in the vicinity of Pantex include the upland chorus frog (Pseudacris triseriata), common bullsnake (Pituophis melanoleucus), western meadowlark (Sturnella neglecta), mourning dove (Zenaida macroura), black-tailed jackrabbit (Lepus californicus), and black-tailed prairie dog (Cynomys ludovicianus). Among the game animals existing onsite are cottontails (Sylvilagus spp.), scaled quail (Callipepla squamata), northern bobwhite *(Colinus virginianus)* , mourning dove, and numerous waterfowl species (PX DOE 1994b:2,3; PX DOE 1994d:8,11). Hunting is not permitted at Pantex. Common raptors on Pantex include the Swainson's hawk (Buteo swainsoni) and burrowing owl (Athene cunicularia). Carnivores present include the American badger (Taxidea taxus) and coyote (Canis latrans). A variety of migratory birds has been found at Pantex. Migratory birds and their nests and eggs, are protected by the Migratory Bird Treaty Act. Eagles are similarly protected by the Bald and Golden Eagle Protection Act.

Wetlands. Wetlands at Pantex are associated with the five playa basins existing on the site and Pantex Lake (also a playa), located approximately 4 km (2.5 mi) northeast of the site. The National Wetland Inventory map identifies Playas 1 through 5 and part of Pantex Lake as wetlands. Playas 1, 2, and 3 are classified by the USFWS as palustrine (nontidal wetlands dominated by trees, shrubs, and emergent vegetation) systems. The larger Playas, 4 and 5, and Pantex Lake are classified as lacustrine (lakes, ponds, and other enclosed open waters at least 8 ha [20 acres] in extent and not dominated by trees, shrubs, or emergent vegetation) systems. Playas 1, 2, and 4 currently receive treated industrial discharges and stormwater runoff, while Playa 3 receives only stormwater runoff. Playa 5 and the Pantex Lake do not receive site discharges. National Wetland Inventory maps identify a number of smaller palustrine wetlands, approximately 4 ha (10 acres) or less, located on the western and southwestern parts of Pantex in areas that are largely grazed or farmed. Situated along the Central Flyway Migratory Route, the Pantex playas are important to migratory birds and provide valuable habitat for nesting and wintering birds, as well.

Aquatic Resources. Aquatic habitat at Pantex is limited to four ephemeral playas, one permanent playa, and several ditches. Although the playas and ditches located on the Pantex site proper may

provide habitat for amphibians and macroinvertebrates, they do not support any fish populations. However, a small pond associated with Pantex Lake does support a small population of minnows (Cyprinidae) (PX DOE 1996b:4-139).

Threatened and Endangered Species. Ten Federal- or state-listed threatened, endangered, and other special status species may be found on and in the vicinity of Pantex (appendix table C-3). Five of these species have records of occurrence on the site, four of which are Federal- and/or state-listed as threatened or endangered. The Federal-listed bald eagle (Haliaeetus leucocephalus) is a winter resident that has been observed foraging at playas on the site each year, while the whooping crane (Grus americana) is considered a very infrequent migrant, last observed in 1990. The state-listed Texas horned-lizard *(Phrynosoma cornutum)* resides on site, while the white-faced ibis (Plegadis chihi) may forage at site playas. The Federal candidate swift fox (*Vulpes velox*) has also been observed onsite. No critical habitat for threatened and endangered species, as defined in the Endangered Species Act (50 CFR 17.11; 50 CFR 17.12), exists on Pantex.

4.5.2.7 *Cultural and Paleontological Resources*

Prehistoric Resources. Archaeological surveys at Pantex have systematically covered approximately one-half of the facility. To date, 63 prehistoric sites have been recorded on DOE and Texas Tech University property. Prehistoric site types identified at Pantex include small temporary campsites and limited activity locations characterized by surface scatters of artifacts. Some of the sites contain heat-altered rock that suggests food processing. Consistent with a Pantex prehistoric site location model, these prehistoric campsites tend to be clustered near the Pantex playa drainages. In this model, prehistoric sites would be located only within 0.4 km (0.25 mi) of playas or their drainages. Of 22 prehistoric sites tested, only one, a late prehistoric bison kill site north of Pantex Lake, has been determined potentially eligible for the NRHP. To date, no activity is planned that would affect this potentially significant site. Other identified sites are thought to be ineligible based on their lack of contextual integrity. A cultural resources management plan is being developed for Pantex. Implementation of this plan is scheduled for 1997. An interim programmatic agreement is in place to ensure regulatory compliance, and potential adverse impacts are evaluated on a case-by-case basis.

Historic Resources. The Pantex facility was originally constructed in 1942 as a World War II bomb-loading plant on land claimed from local farmers. Remains of eight of these farmsteads have been recorded as historic archaeological sites; these sites have minimal integrity and are highly unlikely to be eligible for the NRHP.

The entire Pantex site has been surveyed for World War II-era structures and foundations, and all such properties have been systematically recorded. The Texas SHPO has listed 45 of these structures as potentially eligible for the NRHP. The Cold War historic context has not yet been fully defined for Pantex. When completed, it is probable that a number of plant structures will be determined NRHP eligible.

Native American Resources. Native Americans known to have traditional interests in Pantex include the Comanche Tribe of Oklahoma, the Kiowa Tribe of Oklahoma, the Apache Tribe of Oklahoma, the Mescalero Apache Tribe, the Jicarilla Apache Tribe, the Cheyenne-Arapaho Tribe of Oklahoma, the Wichita and Affiliated Tribes, the Caddo Tribe of Oklahoma, the Delaware Tribe of Western Oklahoma, and the Fort Sill Apache Tribe. DOE is performing a historic treaties search and a public outreach program to involve Native American stakeholders in decisionmaking related to the use of plant land and the protection of cultural resources. Traditional cultural properties have not

been identified at Pantex, but the remains of temporary historic campsites and hunting locations are possible.

Paleontological Resources. 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 contains Late Pleistocene vertebrate remains, including bison, camel, horse, mammoth, and mastodon, with occasional and significant evidence of their use by early humans. Evidence of woolly mammoths has been found north of Pantex near the Canadian River.

4.5.2.8 *Socioeconomics*

Socioeconomic characteristics addressed at Pantex include employment, regional economy, population, housing, and public finance. Statistics for employment and regional economy are presented for the regional economic area that encompasses 32 counties surrounding Pantex in Texas and New Mexico. Statistics for population, housing, and public finance are presented for the ROI, a four-county area in which approximately 96 percent of all Pantex employees reside: Armstrong County (1 percent), Carson County (11 percent), Potter County (34 percent), and Randall County (50 percent). Site employment at Pantex totalled 3,555 in 1994 and is projected to decrease to 1,644 by 2005. Figure 4.5.2.8-1 presents a map of the counties and selected cities composing the Pantex regional economic area and ROI. Supporting data are shown in appendix D.

Regional Economy Characteristics. Selected employment and regional economy statistics for the Pantex regional economic area are summarized in figure 4.5.2.8-2 *(not available electronically)*. The civilian labor force in the regional economic area grew approximately 9 percent between 1980 and 1990 (about 1 percent annually). Total employment in the region was 219,504 in 1994. In 1994, unemployment in the regional economic area was 4.8 percent, significantly lower than 6.4 and 6.3 percent unemployment in Texas and New Mexico, respectively. The 1993 per capita income in the regional economic area was $19,310, approximately 1.5 percent higher than the per capita income in Texas ($19,023) and 19 percent higher than New Mexico's per capita income of $16,346.

As shown in figure 4.5.2.8-2 *(not available electronically)*, the Pantex regional economic area, Texas, and New Mexico have similar employment patterns. The service sector accounts for the largest share of total employment in both Texas and New Mexico (28 percent in both states), as well as in the region (22 percent). Manufacturing, however, accounts for a greater share of employment in Texas (11 percent) than in the region (9 percent) or New Mexico (6 percent).

Population and Housing. The ROI population, which totalled 200,052 in 1992, increased by approximately 10 percent (less than 1 percent annually) between 1980 and 1992, less than half the growth rate of Texas during the same period. Furthermore, population growth was uneven among the ROI counties; Randall County grew about 22 percent (an annual rate of almost 2 percent) while the populations of Carson and Armstrong Counties decreased slightly.

Increases in the number of housing units averaged approximately 1 percent annually in the ROI from 1980 to 1990, less than the almost 3 percent annual increase for Texas. Within the ROI, the number of housing units increased at a rate of almost 3 percent in Randall County, while the number of units decreased slightly in both Carson and Potter Counties. Homeowner and rental vacancy rates in the Pantex ROI in 1990 were comparable to those in Texas. Population and housing statistics for the ROI are summarized in figure 4.5.2.8-3.

Public Finance. Financial characteristics of the local jurisdictions in the Pantex ROI that are most likely to be affected by the proposed action are presented in this section. The data reflect total revenues and expenditures of each jurisdiction's general fund, special revenue funds, and, as applicable, debt service, capital project, and expendable trust funds. School district boundaries may or may not coincide with county or city boundaries, but the districts are presented under the county where they primarily provide services. Major revenue and expenditure fund categories for counties, cities, and school districts are presented in appendix tables D.2.3-6 and D.2.3-7. Figure 4.5.2.8-4 *(not available electronically)* summarizes local governments' revenues and expenditures. Fund balances, which are dollars carried over from previous years, are not included in figure 4.5.2.8-4 *(not available electronically)*. All jurisdictions assessed had positive fund balances.

4.5.2.9 *Radiation and Hazardous Chemical Environment*

The following section provides a description of the radiation and hazardous chemical environment at Pantex. Also included are discussions of health effects studies, emergency preparedness considerations, and a brief accident history.

Radiation Environment. Major sources of background radiation exposure to individuals in the vicinity of Pantex are shown in table 4.5.2.9-1. All annual doses to individuals from background radiation are expected to remain constant over time. The incremental total dose to the population would result only from changes in the size of the population. Background radiation doses are unrelated to Pantex operations.

Table 4.5.2.9-1.-- ***Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Pantex Plant Operations***

Source	Committed Effective Dose Equivalent (mrem/yr)
Natural Background Radiation	
Cosmic and external terrestrial cosmogenic radiation[20]	95
Internal terrestrial radiation[21]	39
Radon in homes (inhaled)[21]	200
Other Background Radiationb	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and Industrial Products	10
Total	399

Releases of radionuclides to the environment from Pantex operations provide another source of radiation exposure to people in the vicinity of Pantex. The radionuclides and quantities released from Pantex operations in 1994 are listed in the 1994 Environmental Report for Pantex Plant (DOE/AL/65030-9506). The doses to the public resulting from these releases are given in table 4.5.2.9-2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1994 report were used in the development of the reference environment (No Action) radiological releases at Pantex in 2005 (section 4.5.3.9).

Based on a dose-to-risk conversion factor of 500 cancer deaths per 1 million person-rem ($5x10^{-4}$ fatal cancer per person-rem) to the public (appendix E), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from Pantex operations in 1994 is estimated to be approximately 2.9x10-11. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of Pantex operations is less than 3 chances in 100 billion. (Note that it takes several to many years from the time of exposure to radiation for a cancer to manifest itself.)

Based on the same conversion factor, $7.0x10^{-8}$ excess fatal cancersare projected in the population living within 80 km (50 mi) of Pantex from normal operation in 1994. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this mortality rate, the number of fatal cancers from all causes expected to occur during 1994 in the population living within 80 km (50 mi) of Pantex was 550. This number of expected fatal cancers is much higher than the estimated $7.0x10^{-8}$ fatal cancers that could result from Pantex operations in 1994.

Table 4.5.2.9-2.-- ***Doses to the General Public from Normal Operation at Pantex Plant, 1994 (Committed Effective Dose Equivalent)***

	Atmospheric Releases		Liquid Releases		Total	
Affected Environment	**Standard[22]**	**Actual**	**Standard[22]**	**Actual**	**Standard[22]**	**Actual**
Maximally exposed individual (mrem)	10	$5.8x10^{-5}$	4	0.0	100	$5.8x10^{-5}$
Population within 80 kilometers [23] (person-rem)	None	$1.4x10^{-4}$	None	0.0	100	$1.4x10^{-4}$
Average individual within 80 kilometers [24] (mrem)	None	$5.0x10^{-7}$	None	0.0	None	$5.0x10^{-7}$

Table 4.5.2.9-3.-- ***Doses to the Onsite Worker from Normal Operation at Pantex Plant, 1994***

	Onsite Releases and Direct Radiation	
Affected Environment	**Standard**[25]	**Actual**[26]
Average worker (mrem)	None	10
Maximally exposed worker (mrem)	5,000	660
Total workers (person-rem)	None	30

Workers at Pantex receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 4.5.2.9-3 includes the average, maximum, and total occupational doses to Pantex workers from operations in 1994. These doses fall within radiological limits (10 CFR 835). Based on a dose-to-risk conversion factor of 400 fatal cancers per 1 million person-rem ($4x10^{-4}$ fatal cancers per person-rem) among workers (appendix E), the number of excess fatal cancers to Pantex workers from operations in 1994 is estimated to be 0.012.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the Pantex Plant Site Report for Calendar Year 1994. In addition, the concentrations of radioactivity in various environmental media (e.g., air, water, and soil) in the onsite and offsite site regions are presented in the same reference. Pantex operations contribute only small amounts of radioactivity to all these media.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in sections 4.5.2.3 and 4.5.2.4.

Adverse health impacts to the public can be minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operation at Pantex via inhalation of air containing hazardous chemicals released to the atmosphere by Pantex operations. Risks to the public health from ingestion of contaminated drinking water or by direct exposure are also potential pathways.

Baseline air emission concentrations for hazardous air pollutants and their applicable standards are presented in section 4.5.2.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. All annual concentrations are compared with applicable guidelines and regulations. Information about estimating health impacts from hazardous/toxic chemicals is presented in appendix

E.

Exposure pathways to Pantex workers during normal operation may include inhaling the workplace atmosphere, drinking Pantex potable water, and possible other contact with hazardous materials associated with particular work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. Pantex workers are also protected by adherence to OSHA and EPA occupational standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operating processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at Pantex are expected to be substantially better than required by standards.

Health Effects Studies. Only one mortality study and one cancer incidence epidemiological study of the general population in communities surrounding Pantex has been performed, and only one study of workers has been done. Significant increases in prostate cancer mortalities among males in Potter and Randall Counties and leukemia mortalities among Carson County males were observed between 1981 and 1992. The analysis on excess cancer incidence found no statistically significant excesses in males. Workers were reported to show a nonstatistically significant excess of brain cancer and leukemia in the one study conducted, but the small number of cases could be attributed to chance alone. For a more detailed description of the studies reviewed and the findings, refer to appendix section E.4.5.

Accident History. There have been no plutonium-dispersing detonation accidents during nuclear weapons operations at Pantex. In 1989, during a weapon disassembly and retirement operation, a release of tritium in the assembly cell occurred. As a result, four workers received negligible doses and a fifth worker received a dose of 1.4 mrem.

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response to accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with planning, preparedness, and response.

Pantex has an emergency management plan, with guidance on implementation provided by a series of Emergency Preparedness Procedures manuals, to protect life and property within the facility, the health and welfare of surrounding areas, and the defense interests of the Nation during any credible emergency situation. Formal mutual assistance agreements have been made with Federal, State of Texas, and local governments. Federal agreements include Interagency Agreements with the Federal Bureau of Investigation for security-based events requiring its efforts, Veteran's Administration for maintenance of an Emergency Radiation Treatment Facility, LLNL for plume modeling information and data from the Atmospheric Release Advisory Center, and the U.S. Army for Explosives Ordnance Disposal. The DOE/State of Texas Agreement-in-Principle contains both DOE and State activities to mutually improve and integrate both Pantex and State of Texas emergency preparedness programs for potential Pantex-generated emergencies. Memoranda of Understanding among the city of Amarillo, Carson County, and Randall County are in place for mutual assistance and aid in the

event of a Pantex-generated emergency. Under accident conditions, an emergency coordinating team of DOE and Pantex contractor management personnel would initiate the Pantex Emergency Plan and coordinate all onsite actions.

If offsite areas could be affected, the Texas Department of Public Safety would be notified immediately, and would make emergency announcements to the public and local governmental agencies in accordance with Annex R of the State of Texas Emergency Management Plan. Pantex has radiological assistance teams with a total of 46 personnel who are equipped and trained to respond to an accident involving radioactive contamination either onsite or offsite.

In addition, the Joint Nuclear Accident Coordination Center in Albuquerque, NM, can be called upon should the need arise. This would mobilize radiation emergency response teams from DOE, DOD, and other participating Federal agencies.

4.5.2.10 *Waste Management*

This section outlines the major environmental regulatory structure and ongoing waste management activities for Pantex. A more detailed discussion of the ongoing waste management operation is provided in appendix section **H.2.4** .

DOE is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at Pantex. The activities DOE is engaged in to bring its operations into full regulatory compliance are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements and financial penalties. These agreements have been reviewed to assure the proposed actions are allowable under the terms of these agreements.

EPA Region 6 on July 29, 1991, proposed Pantex for listing on the NPL of Superfund cleanup sites. Independent evaluations questioned this proposed listing and DOE dissented on the proposal. In September 1991, DOE submitted to EPA its technical comments regarding the proposed listing. EPA placed Pantex on the NPL on May 31, 1994. The DOE Amarillo Area office is currently negotiating a tri-party Federal Facility Agreement with the EPA and the State of Texas. Currently all environmental restoration activities are conducted in compliance with an RCRA permit issued in April 1991. Environmental restoration activities are expected to be completed in 2000.

Pantex's waste management goals are to avoid waste generation or minimize the volume of waste generated to the extent that is technologically and economically practicable, reduce the hazard of waste through substitution or process modification, minimize contamination of existing or proposed real property and facilities, minimize exposure and associated risks to human health and the environment to as low as reasonably achievable levels, and ensure safe, efficient, and compliant long-term management of all wastes. Pantex manages four broad waste categories: low-level, mixed, hazardous, and nonhazardous. Pantex does not generate or manage spent nuclear fuel or HLW. Pantex does not generate TRU waste as a result of normal operation. In the unlikely event that any TRU waste is generated, it would be stabilized and packaged in an appropriate container until shipment to a DOE-approved storage site. A discussion of the waste management operations associated with the remaining categories follows.

Low-Level Waste. LLW generated at Pantex consists of radioactive waste materials associated with weapons A/D, such as protective clothing, cleaning materials, filters, and other similar materials. In

1994, Pantex generated 33 m^3 (8,720 gal) of liquid and 122 m^3 (160 yd3) of solid LLW (PX 1995a:2). Liquid LLW is being stored onsite awaiting a treatment process. Compactible wastes are processed at Pantex's Solid Waste Compaction Facility and staged along with the noncompactible wastes for shipment to a DOE-approved disposal site and/or a commercial vendor. Pantex's LLW is currently shipped to NTS for disposal.

Mixed Low-Level Waste. Mixed LLW is generated during various production, maintenance, modification, and dismantlement functions. For 1994, Pantex generated approximately 1 m^3 (264 gal) of liquid and 15 m^3 (20 yd3) of solid mixed LLW (PX 1995a:2). These wastes consist primarily of small quantities of material such as radioactively contaminated solvents and wipes contaminated by organic solvents and radioactive scrap metal. Mixed LLW is currently stored onsite in RCRA-permitted facilities. Pantex has received exemptions to DOE Order 5820.2A, Radioactive Waste Management for mixed waste shipments to two RCRA-permitted commercial facilities. Pantex developed the *Pantex Plant Compliance Plan* to provide mixed waste treatment capability for all mixed waste streams in accordance with the *Federal Facility Compliance Act* of 1992. This plan was approved by the Texas Natural Resources Conservation Commission and adopted through an Agreed Order on September 27, 1995. The Agreed Order signed by the State of Texas on October 2, 1995, requires implementation of this plan.

Hazardous Waste. Pantex received an RCRA Part B hazardous waste permit from EPA and the Texas Natural Resources Conservation Commission on April 25, 1991. This permit authorizes Pantex to manage hazardous and industrial solid wastes listed in the permit. The permit also requires Pantex to notify the Texas Natural Resources Conservation Commission of the discovery of any release of hazardous waste or hazardous constituents that may have occurred from any solid waste management unit. The hazardous waste permit specifically excluded the 17 RCRA units at the HE Burning Ground that are currently operated under interim status with a written grant of authority for air emissions from the Texas Natural Resources Conservation Commission. Pantex has submitted a request to the Texas Natural Resources Conservation Commission for an RCRA Part B permit modification to add these units at the Burning Ground. A decision on this modification has not been reached.

Most of the hazardous waste generated by Pantex results from HE operations; however, electroplating and photographic and various other operations also generate additional hazardous waste streams. In 1994, Pantex generated 16 m^3 (4,230 gal) of solvent-contaminated wastewater, explosives-contaminated wastewater, and spent organic solvents contaminated with explosives. Solid hazardous wastes included approximately 177 m^3 (232 yd^3) of RCRA-regulated and 8 m^3 (10 yd^3) of TSCA-regulated wastes (PX 1995a:2). HE, HE support material, HE-contaminated materials, and HE-contaminated solid wastes are burned under controlled conditions at Pantex's Burning Ground. Ash, debris, and residue resulting from this burning are transported offsite for approved disposal at a commercial RCRA-permitted facility. All other hazardous waste generated at Pantex, including various chemicals, solvents, heavy metals, and other hazardous constituents, are manifested and shipped offsite by DOT-certified transporters for recycling or disposal at a commercial RCRA-permitted facility.

Nonhazardous Waste. Nonhazardous solid and liquid sanitary wastes are generated at Pantex. An estimated 476,000 m^3 (125,700,000 gal) of sewage wastewater and 4,190 m^3 (1,107,000 gal) of other wastewater was generated in 1994 (PX 1995a:2). Sewage and some pretreated industrial wastewater are treated by the sanitary sewage wastewater treatment system. The liquid effluent from the system is discharged into a playa, where it then either evaporates or filtrates into the ground. Liquid industrial

waste is also treated in a tank system that removes metals from plating solutions and then neutralizes this solution. The effluent from this process is discharged to a playa, which is permitted by the Texas Natural Resources Conservation Commission. Stormwater discharges are regulated by a NPDES permit. A proposed upgrade to the sanitary wastewater sewer treatment system would permit all industrial wastewater and sewage to be treated at one location.

Nonhazardous solid waste generated onsite consists primarily of paper, cardboard, construction waste, and cafeteria waste. For 1994, Pantex generated approximately 824,400 kg (1,817,500 lb) of solid sanitary waste (PX 1995a:2). Seventy percent of the solid sanitary waste was disposed of at the City of Amarillo Landfill. The remainder was shipped offsite to other treatment/disposal facilities. In addition, 47,400 m^3 (62,000 yd^3) of construction debris were generated (PX 1995a:2). Only construction wastes are disposed of onsite. Prior to late 1989, sanitary waste was disposed of onsite. Since then, sanitary waste has been transported to the City of Amarillo Landfill for disposal. Waste asbestos is sent to an offsite permitted landfill.

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1 System capacity is 201,480 MWh/yr.

2 System capacity is 22.5 MWe.

3 System capacity is 289,000,000 m**3** /yr.

4 System capacity is 68,040 kg/hr. PX 1996e:1; PX DOE 1995g; PX DOE 1996b.

5 Federal standard.

6 No monitoring data available; baseline concentration assumed less than applicable standard.

7 State standard. The effects screening levels are used in evaluation of hazardous and other toxic compounds.

8 1-hour predicted concentrations were used for 30-minute standard.

9 No standard. Source: 40 CFR 50; PX DOE 1996b; TX ACB 1987a; TX NRCC 1992a; TX NRCC 1995a.

10 For comparison only.

11 National Primary Drinking Water Regulations (40 CFR 141).

12 Proposed National Primary Drinking Water Regulation; Radionuclides (56 FR 33050).

13 DOE Derived Concentration Guides for water (DOE Order 5400.5). Number used is 4 percent of Derived Concentration Guides.

14 National Secondary Drinking Water Regulations (40 CFR 143). NA - not applicable; <MDA indicates the results were less than the minimum detectable activity of the radionuclide counting

system; parentheses () indicate standard deviation from the mean. If no parentheses are given for the radionuclide, then a mean could not be be calculated. PX DOE 1995d.

15 For comparison only, except for those parameters with the Texas State water quality criteria.

16 National Primary Drinking Water Regulations (40 CFR 141).

17 Proposed National Primary Drinking Water Regulation; Radionuclides (56 FR 33050).

18 DOE Derived Concentration Guides for water (DOE Order 5400.5). Number used is 4 percent of Derived Concentration Guides.

19 National Secondary Drinking Water Regulations (40 CFR 143). NA - not applicable; <MDA indicates the results were been that the minimum detectable activity of the radionuclide counting system; parentheses ( ) indicate standard deviation from the mean, if no parentheses are given for the radionuclide, then a mean could not be be calculated. PX DOE 1995d.

20 PX DOE 1995d.

21 NCRP 1987a. Value for radon is an average for the United States.

22 The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the *SDWA* , and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed
10 CFR 834 (58 FR 16268).

23 In 1994, this population was approximately 275,000.

24 Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site. Source: PX DOE 1995d.

25 10 CFR 835. DOE's goal is to maintain radiological exposure as low as reasonably achievable.

26 PX DOE 1995d. The number of badged workers in
1994 was approximately 2,980.

4.6.3 Environmental Impacts

4.6.3.1 Land Use

No Action. Under No Action, DOE would continue current and planned activities at LANL as described in section 3.2.6. No additional land use impacts are anticipated at LANL beyond the effects of the existing and future activities that are independent of the proposed action.

Management Alternatives

Pit Fabrication. The existing plutonium facility at LANL would be modified to support this alternative. Additional land would not be used to implement the new mission. The proposed activity would be compatible and consistent with land use plans and policies. Impacts to land use are not expected.

Secondary and Case Fabrication. The secondary and case fabrication alternative at LANL would use existing facilities, equipment, and infrastructure to support production requirements for the secondary fabrication mission. Only minimal modifications to existing facilities at LANL would be required. Additional land would not be used to implement the new mission. These activities would be compatible and consistent with land use plans and policies. Impacts to land use are not expected.

High Explosives Fabrication. The proposed HE fabrication activities would be conducted in existing LANL facilities. No new facilities or structures would be required to support HE fabrication. Additional land would not be used to implement the mission. The proposed activity would be compatible and consistent with land use plans and policies. Impacts to land use are not expected.

Nonnuclear Fabrication. LANL would use existing facilities to support nonnuclear fabrication activities. Additional land would not be used to implement the mission. The proposed activity would be compatible and consistent with land use plans and policies. Impacts to land use are not expected.

Sensitivity Analysis . LANL would be able to accommodate the high and low case production operations for all management alternatives with base case production facilities. No land-use impacts are expected.

Stewardship Alternatives

Proposed National Ignition Facility. The proposed location of NIF at LANL is within TA-58. An estimated 4 ha (10 acres) of land for buildings, walkways, building access, and buffer space would be required to construct and operate NIF. The land required for the proposed NIF would represent approximately 1 percent of the land currently available for development within LANL. However, 4 ha (10 acres) represents an extremely small proportion of LANL's total land area of 111 km^2 (43 mi^2). The proposed NIF is compatible and consistent with land-use plans for this area. No impacts to LANL land-use plans or policies are expected.

Proposed Atlas Facility. The proposed Atlas Facility would include existing buildings located in a developed area within TA-35 at LANL. Modification activities would involve renovating the existing buildings for use in performing pulsed-power experiments. The area is currently used for similar types of activities. The proposed Atlas Facility activity would be compatible and consistent with land

use plans for the area. Impacts to LANL land-use plans and policies are not expected.

Combined Program Impacts. Of the six potential Stockpile Stewardship and Management Program alternatives proposed for LANL, existing facilities would be modified for five of the alternatives. No additional land would be used to implement the mission. The proposed NIF would require clearing 4 ha (10 acres) of undeveloped land for buildings, walkways, and buffer space. The total land use impact from placing all potential Program alternatives at LANL would be the use of 4 ha (10 acres) of undeveloped land in TA-58 for the new NIF mission.

Potential Mitigation Measures . No mitigation measures for stockpile stewardship and management alternatives at LANL are anticipated.

4.6.3.2 Site Infrastructure

This section discusses site infrastructure at LANL for No Action and the modifications needed for actions due to construction and operation of stockpile stewardship and management facilities. A comparison of site infrastructure and facility resource needs for No Action and the proposed alternatives is presented in table 4.6.3.2-1.

No Action. This alternative continues the management missions, described in section 3.2.6, of limited pit fabrication and selected nonnuclear fabrication, and the stewardship R&D missions. As stated in section 1.6.2, the Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility is considered part of No Action. Impacts on site infrastructure would be minimal since the Pulsed High Energy Radiation Machine Emitting X-Rays (PHERMEX) Facility would be phased out as the DARHT Facility becomes operational. As shown in table 4.6.3.2-1, the site infrastructure would continue to adequately supply facility requirements.

Management Alternatives

Pit Fabrication. As shown in table 4.6.3.2-1, site infrastructure would require slight facility improvements to meet pit fabrication requirements. Only a slight increase over No Action requirements in electrical energy and natural gas use is expected. No other impacts to site infrastructure are expected.

Secondary and Case Fabrication. Site infrastructure would require slight facility improvements to meet secondary and case fabrication requirements. Table 4.6.3.2-1 shows the total site requirement with secondary and case fabrication and the change from No Action. Impacts to site infrastructure include a 9-percent increase in electrical energy use over No Action requirements. The electric power pool has sufficient capacity margins to accommodate the secondary and case fabrication mission. There would also be an increase in liquid fuel use.

High Explosives Fabrication. Site infrastructure would require minor facility improvements to meet HE fabrication requirements. Impacts to site infrastructure include an increase in liquid fuel use over No Action requirements. An 8-percent increase in natural gas use would occur, but there would be only a slight increase in electrical energy use over No Action requirements. This analysis assumes the entire HE mission is relocated to LANL. If it is shared with LLNL, the impact would be proportionately less.

Nonnuclear Fabrication. Minor site infrastructure facility improvements would be needed to meet

nonnuclear fabrication requirements. As shown in table 4.6.3.2-1, only a slight increase in energy use is expected. No other impacts to site infrastructure are expected.

Sensitivity Analysis . No change in site infrastructure impacts are expected for the high and low production case for pit, secondary and case, and HE fabrication. For nonnuclear fabrication, the high production case would require using additional facilities, namely Buildings 300 and 301 at S-Site. Also, additional capital equipment would need to be added to increase processing, storage, and inventory control capability. No additional site infrastructure changes would be needed to meet the low production case.

Stewardship Alternatives

Proposed National Ignition Facility. As shown in table 4.6.3.2-1, site infrastructure would require slight facility improvements to meet the proposed NIF requirements. Impacts to site infrastructure include a 11-percent increase in electrical energy use, a 22-percent increase in peak electrical loads, and a 2-percent increase in natural gas use over No Action requirements. The electric power pool has sufficient capacity margins to accommodate the proposed NIF.

Table 4.6.3.2-1.-- Site Infrastructure Requirements and Changes for Stockpile Stewardship and Management Alternatives at Los Alamos National Laboratory

	Electrical		Fuel		
Alternative	Energy (MWh/yr)	Peak Load (MWe)	Liquid (L/yr)	Gas (m^3 /yr)	Coal (t/yr)
Current Resources	381,425	87	0	43,414,560	NA
No Action (2005)					
Total site requirement	381,425	87	0	43,414,560	NA
Change from current resources	0	0	0	0	NA
Nonnuclear Fabrication					
Total site requirement	381,950	87.2	0	43,414,900	NA
Change from No Action	525	0.23	0	340	NA
Pit Fabrication					
Total site requirement	386,905	87.7	0	43,445,460	NA
Change from No Action	5,480	0.7	0	30,900	NA
Secondary and Case Fabrication					
Total site requirement	417,425	92	100,000	43,414,560	NA

Change from No Action	36,000	5	100,000	0	NA
High Explosives Fabrication					
Total site requirement	387,025	88	94,600	47,064,560	NA
Change from No Action	5,600	1	94,600	3,650,000	NA
National Ignition Facility					
Total site requirement	423,425	107	2,800	44,224,560	NA
Change from No Action	42,000	20	2,800	810,000	NA
Atlas Facility					
Total site requirement	386,785	87	0	43,414,560	NA
Change from No Action	5,360	0[1]	0	0	NA
Combined Program Impacts					
Total site requirement	476,390	113.9	197,400	47,905,800	NA
Change from No Action	94,965	26.9	197,400	4,491,240	NA

Proposed Atlas Facility. The LANL site infrastructure would require minor facility improvements to meet the proposed Atlas Facility requirements. Table 4.6.3.2-1 shows the expected change in site requirements to support the Atlas Facility. Impacts to site infrastructure include no increase in peak electrical load requirements due to utilization of existing generators currently used for other experiments and only a slight increase in electrical energy use over No Action requirements. No other impacts to site infrastructure are expected.

Combined Program Impacts. If all of the alternatives applicable to LANL were to be located there, the combined impacts would exceed current site infrastructure resources. The largest impact would be a 25-percent increase in electrical energy use with an associated 31-percent increase in peak electrical load. Natural gas use would increase by 10 percent. Consumption of liquid fuel, which is currently used for standby power only and shows no amount in table 4.6.3.2-1, would increase to about 197,400 L per year.

Potential Mitigation Measures. No mitigation measures are anticipated.

4.6.3.3 Air Quality

No Action. No Action air quality utilizes estimated air emissions data from operations at LANL in 2005, assuming continuation of current site missions, to calculate pollutant concentrations at or beyond the LANL site boundary. Included in the criteria and toxic/hazardous emissions from LANL are those emissions estimated for operation of the DARHT Facility currently under construction. The emission rates for criteria and toxic/hazardous pollutants for No Action are presented in appendix table B.3.6-1. Table 4.6.3.3-1 presents the No Action pollutant concentrations calculated from the 2005 emission rates. In this table, pollutant concentrations are compared with applicable Federal and state regulations and guidelines. Concentrations are expected to remain within these standards.

Table 4.6.3.3-1.-- Estimated Concentrations of Pollutants from No Action and Stockpile Stewardship and Management Alternatives at Los Alamos National Laboratory

Pollutant	Averaging Time	Most Stringent Regulations or Guidelines (mg/m^3)	2005 No Action (mg/m^3)	Pit Fabrication (mg/m^3)	Secondary and Case Fabrication (mg/m^3)	High Explosives Fabrication (mg/m^3)	Nonnu Fabric (mg/
Criteria Pollutant							
Carbon monoxide	8-hour	7,689[2]	115	116.81	138.97	139.17	11
	1-hour	11,578[2]	630	639.90	761.46	762.51	63
Lead	Calendar quarter	1.5[3]	0.00002	0.00002	0.01	0.00002	0.00
Nitrogen dioxide	Annual	73[2]	3.84	3.84	16.82	6.36	3.8
	24-hour	145[2]	2	2	233.12	46.8	2
Ozone	1-hour	235[3]	139	139	139	139	13
Particulate matter	Annual	50[3]	8.01	8.01	8.04	8.04	8.0
	24-hour	150[3]	24.3	24.3	24.89	24.84	24
Sulfur dioxide	Annual	40[2]	1.3	1.3	6.63	1.3	1.
	24-hour	202[2]	0.006	0.006	94.83	0.006	0.0
	3-hour	1,300[3]	0.03	0.03	467.43	0.03	0.0
Mandated by New Mexico							
Hydrogen sulfide	1-hour	11[2]	[4]	[4]	[4]	[4]	[4]
Total reduced sulfur	30-minute	3[2]	[4]	[4]	[4]	[4]	[4]
Total suspended particulates	Annual	60[2]	8	8.06	8.03	8.03	8
	30-day	90[2]	<21	<21	<21.59	<21.54	<2
	7-day	110[2]	<21	<21	<21.59	<21.54	<2
	24-hour	150[2]	21	21	21.59	21.54	2
Hazardous and Other Toxic Compounds							

Acetic acid	8-hour	250[2]	2.87	2.87	2.87	2.87	2.8
Ammonia	8-hour	180[2]	4.27	4.27	4.27	6.69	4.2
2-Butoxyethanol	8-hour	1,200[2]	0.66	0.66	0.66	0.66	0.6
Chlorine	8-hour	[5]	0.07	1.89	0.07	0.07	0.0
Chloroform	8-hour	500[2]	2.61	2.61	2.61	2.61	2.6
Ethyl acetate	8-hour	14,000[2]	0.44	0.44	0.44	0.44	0.4
Ethylene glycol	8-hour	[5]	0.39	0.39	0.39	0.39	0.3
Formaldehyde	8-hour	15[2]	0.24	0.24	0.24	0.24	0.2
Heavy metals	8-hour	[5]	0.62	0.62	0.62	0.62	0.6
p Heptane (N-heptane)	8-hour	[5]	9.06	9.06	9.06	9.06	9.0
Hexane (N-hexane)	8-hour	[5]	0.41	0.41	0.41	0.41	0.4
Hpydrogen chloride	8-hour	[5]	3.41	3.41	3.41	4.01	3.4
Hydrogen fluoride	8-hour	[5]	1.29	1.29	1.29	1.54	1.2
Isopropyl alcohol	8-hour	9,800[2]	2.88	2.88	2.88	2.88	2.8
Kerosene	8-hour	[5]	1.27	1.27	1.27	1.27	1.2
Methpyl alcohol	8-hour	[5]	3.14	3.46	3.14	3.14	3.1
Methyl ethyl ketone	8-hour	[5]	9.95	9.95	9.95	10.08	9.9
Methylene chloride	8-hour	[5]	5.90	5.90	5.90	5.90	5.9
Nickel	8-hour	10[2]	0.27	0.27	0.27	0.27	0.2
Nitric acid	8-hour	50[2]	3.53	3.53	3.53	3.53	3.5
Nitrogen oxide	8-hour	[5]	2.29	2.29	2.29	2.29	2.2
Non methane hydrocarbons	8-hour	[5]	15.83	15.83	15.83	15.83	15.
Propane sultone	8-hour	[5]	1.00	1.00	1.00	1.00	1.0
Stoddard solvent	8-hour	5,250[2]	1.41	1.41	1.41	1.41	1.4
Toluene	8-hour	[5]	13.26	13.26	13.26	13.38	13.

Tungsten (as W) (insoluble)	8-hour	50[2]	0.53	0.53	0.53	0.53	0.5
1,1,2-Trichloroethane	8-hour	[5]	4.95	4.95	4.95	4.95	4.9
Trichloroethylene	8-hour	[5]	1.12	1.12	1.12	1.12	1.1
VM&P naphtha	8-hour	13,500[2]	3.27	3.27	3.27	3.27	3.2
Welding fumes	8-hour	[5]	2.80	2.80	2.80	2.80	2.8
Xylene	8-hour	[5]	9.41	9.41	9.41	9.41	9.4

Management Alternatives

Pit Fabrication. Operation of the Pit Fabrication Facility would generate criteria and toxic/hazardous pollutants resulting from the combustion of fossil fuels for space heating and manufacturing processes. The emissions consist of particulate matter, carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, and VOCs. Emission rates of criteria and toxic/hazardous pollutants for annual operation of the Pit Fabrication Facility are presented in appendix table B.3.6-1. Table 4.6.3.3-1 presents the concentrations of criteria and toxic/hazardous pollutants resulting from No Action and those generated from operation of the Pit Fabrication Facility. Concentrations of pollutants resulting from operation of this facility added to No Action concentrations are expected to remain within Federal and state regulations.

Secondary and Case Fabrication. The Secondary and Case Fabrication Facility would generate criteria and toxic/hazardous emissions resulting from operation of the plant boiler, component manufacturing, and chemical processes. Reasonably available control technology would be used to minimize pollutant emissions. This would include using HEPA filters to contain particulate emissions and providing liquid scrubbing prior to HEPA filtration to remove chemical vapors such as nitric acid. Emission rates for criteria and toxic/hazardous pollutants for the secondary and case fabrication mission are presented in appendix table B.3.6-1. Table 4.6.3.3-1 presents the concentrations of criteria and toxic/hazardous pollutants resulting from No Action and those generated from operation of the secondary and case fabrication mission. The resulting concentrations of criteria and toxic/hazardous pollutants are expected to remain within Federal and state regulations and guidelines. Modeled estimates for the 24-hour concentration of nitrogen dioxide, however, are above the applicable standard.

High Explosives Fabrication. Gaseous emissions of criteria and toxic/hazardous air pollutants would be generated from HE fabrication. These emissions would result from open burn/open detonation of nonradioactive scrap HE and HE-contaminated waste, plant boiler operation, cleaning operations using solvents, and formulation and synthesis operations. Emission rates for criteria and toxic/hazardous pollutants for HE fabrication are presented in appendix table B.3.6-1. Table 4.6.3.3-1 presents the concentrations of criteria and toxic/hazardous pollutants resulting from No Action and those generated from HE fabrication. The resulting concentrations of criteria and toxic/hazardous pollutants are expected to be within Federal and state regulations and guidelines.

Nonnuclear Fabrication. Aerial emissions of combustion by-products from the slight increase in process steam usage would result in an increase of 159 kg (350 lb) of VOCs. This emission rate is

based upon the increase of natural gas combustion needed to generate an additional 1 million British thermal units of energy. Pollutant emissions of combustion by-products for steam and gas heating systems for normal building operations are not considered, as the facilities are existing and no increases in emissions would occur as a result of the proposed activity. Table 4.6.3.3-1 presents the concentrations of criteria and toxic/hazardous pollutants resulting from No Action and nonnuclear fabrication. Concentrations of pollutants resulting from operation of nonnuclear fabrication added to No Action concentrations are expected to remain within Federal and state regulations.

Sensitivity Analysis. Impacts to air quality from either the low or high case scenario of the program alternative would result in higher and lower concentrations of criteria and toxic/hazardous pollutants for the high and low case, respectively. The concentrations of pollutants for the high case pit fabrication, HE, and nonnuclear fabrication missions are expected to be within applicable Federal and state regulations and guidelines. The 24-hour concentration of nitrogen dioxide for the high case secondary and case fabrication mission is above applicable standards and guidelines.

Stewardship Alternatives

Proposed National Ignition Facility. Operation of the proposed NIF would generate criteria and toxic/hazardous pollutants resulting from the combustion of boiler fuel for heating, operation of diesel generators, and solvent cleaning processes. The emissions consist of particulate matter, carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, and VOCs. Boiler fuel is assumed to be natural gas. Emission rates of criteria and toxic/hazardous pollutants for annual operation of the proposed NIF are presented in appendix table B.3.6-1. Table 4.6.3.3-1 presents the concentrations of criteria and toxic/hazardous pollutants resulting from No Action and those generated from operation of the proposed NIF. Concentrations of pollutants resulting from operation of the proposed NIF added to No Action concentrations are expected to remain within Federal and state regulations.

Proposed Atlas Facility. Operation of the Atlas Facility would not typically generate criteria pollutants; however, for purposes of this analysis it is anticipated that small amounts of lead or other similar heavy metals might be released as a volatilized metal from the target chamber following certain occasional experiments. Toxic/hazardous emissions would be generated by the Atlas Facility following each experiment due to the evaporation of solvents used to clean the inside of the target chamber. The quantity of air emissions resulting from each experiment are small and therefore require no facility air filtration or scrubbers. Emission rates of criteria and toxic/hazardous pollutants for annual operation of the proposed Atlas Facility are presented in appendix table B.3.6-1. Table 4.6.3.3-1 presents the concentrations of criteria and toxic/hazardous pollutants resulting from No Action and those generated from operation of the proposed Atlas Facility. Concentrations of pollutants resulting from operation of the proposed Atlas Facility added to No Action concentrations are expected to remain within Federal and state regulations.

Combined Program Impacts. The combined Program impacts to air quality, assuming that each of the proposed stewardship and management alternatives are located at LANL, are presented in table 4.6.3.3-1. The table presents total program concentrations of criteria and toxic/hazardous pollutants derived by adding the contribution from each alternative. The contribution to air pollutants was determined for each alternative independently from each of the other alternatives. Therefore, adding the respective contributions presents a conservative estimate of the combined impacts to air quality since the maximum pollutant concentration for each alternative would not occur at the same time or location at or beyond the site boundary.

Using this conservative estimate of the combined impacts to air quality at LANL, the data indicate that the 24-hour concentration of nitrogen dioxide may result in a concentration above the applicable State of New Mexico ambient air quality standard. All other criteria and/or toxic/hazardous air pollutants are expected to be within applicable standards.

Potential Mitigation Measures. The use of reasonably available control technology may contribute to the reduction of concentrations of nitrogen dioxide.

4.6.3.4 Water Resources

Environmental impacts associated with the construction and operation of the potential stockpile stewardship and management facilities at LANL could affect surface and groundwater resources. All water required for construction or operation would be supplied from groundwater. The proposed sites for the new or modified facilities would be outside the 100- and 500-year floodplains. A description of the activities that would continue at LANL is provided in section 3.2.6. Table 4.6.3.4-1 presents existing surface water and groundwater resources and the potential changes to water resources at LANL resulting from the proposed alternatives. The total site water resources requirements for each alternative including No Action are displayed in this table. Combined program impacts if all alternatives were implemented at LANL are also listed.

Surface Water

No Action. Since there would be no construction under No Action, no additional construction water would be required or discharged. Current wastewater discharge would remain at 693 MLY in the No Action year 2005.

Management Alternatives

Pit Fabrication. Existing facilities would be modified at TA-55 to accept the pit fabrication mission. Modification activities would take place in TAs atop mesas and would not be affected by a 500-year flood. No surface water would be withdrawn for stockpile stewardship and management activities. Impacts to surface water resources associated with runoff and wastewater discharged during the modification phase would be negligible.

Table 4.6.3.4-1.-- Potential Changes to Water Resources from Stockpile Stewardship and Management Alternatives at Los Alamos National Laboratory

Affected Resource Indicator	No Action Single-Shift Operation 2005	Pit Fabrication Three-Shift Operation	Secondary and Case Fabrication Three-Shift Operation	High Explosives Fabrication Three-Shift Operation	Nonnuclear Fabrication Three-Shift Operation	National Ignition Facility	Atlas Facility
Construction							
Water Availability and Use							

Water source	Ground	Ground	Ground	Ground	Ground	Ground	Ground
Total site water operation requirement[6] (MLY)	0[7]	5,760	5,761	5,760	5,760	5,763	5,760
Percent change from No Action water use (5,760 MLY)	NA	0	0.02	0	0	0.05	0
Water Quality							
Wastewater discharge to surface waters[8]	0[7]	693	693.9	693	693	693.4	693
Percent change from No Action wastewater discharges (693 MLY)	NA	0	0.13	0	0	0.06	0
Operation							
Water Availability and Use							
Water source	Ground	Ground	Ground	Ground	Ground	Ground	Ground
Total site water operation requirement (MLY)	5,760	5790	5,815	5,773	5,808	5,912	5,760
Percent change from No Action water use (5,760 MLY)	NA	0.5	1	0.2	0.8	2.6	0
Percent change from current use (5,519 MLY)	4.4	4.9	5.4	4.6	5.2	7.1	4.4
Percent of groundwater allotment (6,800 MLY)	85	85	86	85	85	87	85

Water Quality							
Wastewater discharge to surface waters[8]	693	705	713	706	694	711	693
Percent change from No Action wastewater discharge (693 MLY)	NA	1.8	2.9	1.8	0.08	2.6	0
Percent change from current wastewater discharge (693 MLY)	0	1.8	2.9	1.8	0.08	2.6	0
Floodplain							
Actions in 100-year floodplain	NA	None	None	None	None	None	None
Actions in 500-year floodplain	NA	None	None	None	None	None	None

During operation, sanitary and other liquid wastes would be treated at the Los Alamos Sanitary Treatment Facility. Treated wastewater would then be discharged to the canyons. The additional sanitary wastewater generated by the processes would be approximately 12.3 MLY (3.2 MGY). This represents an increase of approximately 1.8 percent over the projected sanitary wastewater generation rate of 693 MLY (183 MGY).

Secondary and Case Fabrication. During operation, nonhazardous sanitary liquid wastes would be disposed of by a sanitary collection system. Sanitary process and support liquids are sent by drain to the sanitary wastewater treatment plant (TA-46) and treated similarly to municipal sewage. The additional sanitary wastewater generated by the processes would be approximately 20.4 MLY (5.4 MGY). This represents an increase of approximately 2.9 percent over the projected sanitary wastewater generation rate of 693 MLY (183 MGY). No additional impacts to surface water are anticipated.

While brief downpours can cause local flash flooding, especially in canyons, streams, and other low spots, most of the LANL TAs, including TA-55, are located atop the finger mesas near drainage ditches and are not subject to flooding.

High Explosives Fabrication. During modification activities, no additional sanitary liquid waste or other liquid wastes would be generated. During operation, sanitary liquid and other liquid wastes would be treated at the Los Alamos Sanitary Treatment Facility before being discharged to the canyons. The HE fabrication processes would generate approximately 12.8 MLY (3.38 MGY) of additional sanitary wastewater. This represents an increase of approximately 1.8 percent over the projected sanitary wastewater generation rate of 693 MLY (183 MGY). Treated effluent would be monitored to comply with NPDES-permitted and other applicable discharge requirements. No adverse impacts to surface water or surface water quality are expected.

All proposed HE facilities and buildings at the Los Alamos HE Facility are located above the critical flood elevation of the potential flood source (i.e., river, dam, levee, and precipitation).

Nonnuclear Fabrication. An additional 0.005 MLY (0.001 MGY) of wastewater would be discharged during construction. Sanitary and other liquid wastes would be treated at the Los Alamos Sanitary Treatment Facility and then discharged to the canyons. The processes associated with nonnuclear fabrication would generate approximately 0.57 MLY (0.151 MGY) of additional sanitary wastewater. This represents approximately a 0.08-percent increase in the annual projected sanitary wastewater generation rate of 693 MLY (183 MGY). Treated effluent would be monitored to comply with NPDES permits and with applicable discharge requirements. No adverse impacts to surface water or surface water quality are expected.

Stewardship Alternatives

Proposed National Ignition Facility. The proposed NIF is expected to generate an additional 17.8 MLY (4.7 MGY) of sanitary wastewater. This amount would represent a 2.6-percent increase in the annual projected sanitary wastewater generation rate of 693 MLY (183 MGY). Consolidation of LANL's sewer system was completed in 1994 to bring all treatment systems into compliance with Federal and state regulations. Capacity of the consolidated sewer system would be sufficient to meet project requirements.

Because the canyons south and north of the NIF location are more than 20 m (65.6 ft) deep, the 100-year floodplain is contained within the canyons. Because of the depth of the canyons, impacts from a 500-year flood event are unlikely.

Proposed Atlas Facility. Existing buildings at TA-35 would be renovated for the proposed Atlas Facility. During modification activities and operations, a minimal amount of wastewater would be generated. Current wastewater capacities would be able to meet the additional requirements for the Atlas Facility. Additional information regarding the Atlas Facility at LANL is presented in appendix K. No additional wastewater would be discharged to surface water during construction, modification, or operation activities.

Groundwater

No Action. Water supply at LANL is provided by three DOE-owned well fields. Springs in the area produce approximately 1 percent of the water supply. Approximately 5,760 MLY (1,522 MGY) of water is produced.

Since there would be no construction or modifications under No Action, no additional groundwater for construction would be required. Baseline conditions and operations, described in section 4.6.2.4, would continue, and groundwater withdrawal would remain at 5,760 MLY (1,522 MGY) in 2005. No additional impacts to groundwater quality are anticipated since there are no direct discharges to groundwater.

Management Alternatives

Pit Fabrication. Water requirements for both the building modification activities and operation phase would be supplied from local groundwater sources. Minimal water would be needed during the

building modification activities.

During operation, an additional 30.2 MLY (7.98 MGY) of water would be required to support pit fabrication activities, which is a 0.52-percent increase over the No Action groundwater withdrawal of 5,760 MLY (1,522 MGY). The projected water requirements for modification activities and operation would not constitute significant increases in the total amount of groundwater currently withdrawn by LANL and would not affect water supply in the area. The additional amount would still be below the LANL maximum allotment of 6,800 MLY (1,796 MGY).

Secondary and Case Fabrication. Approximately 1 MLY (0.26 MGY) of groundwater would be required for construction and modification activities.

Operation of the secondary and case fabrication facilities would require approximately 55 MLY (14.5 MGY), which is less than a 1-percent increase over the projected groundwater withdrawal of 5,760 MLY (1,522 MGY). The projected water requirements during operation would not constitute significant increases in the total amount of groundwater currently withdrawn by LANL and would not affect water supply in the area. The additional amount would still be below the LANL maximum allotment of 6,800 MLY (1,796 MGY).

High Explosives Fabrication. No additional groundwater would be needed for HE fabrication building modification activities. During modification, no wastewater would be discharged to groundwater. Adverse impacts to groundwater are not expected.

Operation of the HE fabrication facilities would require approximately 13 MLY (3.4 MGY), which is an increase of less than 1 percent over the projected groundwater withdrawal of 5,760 MLY (1,522 MGY). The projected water requirements during operation would not constitute significant increases in the total amount of groundwater currently withdrawn by LANL and would not affect water supply in the area. The additional amount of water would still be below the LANL maximum allotment of 6,800 MLY (1,796 MGY).

Nonnuclear Fabrication. Approximately 0.004 MLY of additional groundwater would be needed for building modification activities for nonnuclear fabrication. Operation of the nonnuclear fabrication facilities would require approximately 48.3 MLY (12.76 MGY), which is a 0.8-percent increase in the projected groundwater use of 5,760 MLY (1,522 MGY). The projected water requirements during operation would not constitute significant increases in the total amount of groundwater currently withdrawn by LANL, and would not affect water supply in the area.

Groundwater Quality. No process wastes from the proposed management alternatives would be discharged directly to the groundwater, and all treated wastewater discharges to the canyons would be monitored to comply with NPDES permit and other applicable discharge requirements. Given normal safeguards and precautions, no adverse impacts to groundwater quality are expected.

Sensitivity Analysis**.** The effluent discharges to surface waters resulting from the high stockpile case are expected to be similar or slightly greater than the volumes generated by the surge three-shift operation alternatives. The low case scenario would discharge a slightly larger volume of treated effluent compared to the No Action volume. Additional impacts to surface water quality would be negligible. Groundwater quality is not expected to be impacted by the low or high case production scenario at LANL.

Stewardship Alternatives

Proposed National Ignition Facility. During the proposed NIF's 5-year construction period, approximately 3 MLY (0.8 MGY) of water would be required. This amount is a 0.05-percent increase in the (2005) projected groundwater withdrawal of 5,760 MLY (1,522 MGY). Operation of the proposed NIF would require approximately 152 MLY (40.2 MGY), of which 17.8 MLY (4.7 MGY) would be for domestic use. This amount is a 2.6-percent increase in the projected groundwater withdrawal of 5,760 MLY (1,522 MGY). The projected water requirements during operation would not constitute significant increases in the total amount of groundwater projected to be withdrawn by LANL and would not affect water supply in the area. This additional amount would still be below the LANL maximum allotment of 6,800 MLY (1,800 MGY).

Proposed Atlas Facility. Existing buildings at TA-35 would require renovation for the proposed Atlas Facility. During modification activities and operation, a minimal amount of water would be required. Current water capacities would be able to meet the additional requirements for the proposed Atlas Facility. Additional information regarding the Atlas Facility at LANL is presented in appendix K.

Groundwater Quality. No process wastes from the proposed stewardship alternative would be discharged directly to the groundwater, and all treated wastewater discharges to the canyons would be monitored to comply with NPDES permit and other applicable discharge requirements. Given normal safeguards and precautions, no adverse impacts to groundwater quality are expected.

Combined Program Impacts. The combined Program impacts to water resources if each proposed alternative were implemented at LANL are shown in table 4.6.3.4-1. A negligible amount of water would be required for modification activities. Approximately 6,059 MLY (1,600 MGY) of groundwater would be required to operate the facilities; this represents a 5.2-percent increase in projected groundwater use and 89 percent of the current groundwater allotment at LANL. Wastewater discharges during construction and operation of the facilities would total approximately 0.6 MLY (0.2 MGY) and 64 MLY (17 MGY), respectively. All wastewater would be discharged to surface waters and would be monitored to comply with NPDES permit and other applicable discharge requirements. Given normal safeguards and precautions, no adverse impacts to surface water or groundwater quality are expected.

Potential Mitigation Measures. Because appropriate erosion and runoff management measures would be implemented during construction to comply with NPDES stormwater management regulations, no mitigation measures should be necessary. Stormwater measures include erosion control measures such as silt fences, dikes, and sediment traps to divert runoff away from disturbed areas and stabilization practices that cover soils with materials such as riprap or mulch in order to prevent direct exposure of soils to runoff.

4.6.3.5 Geology and Soils

The proposed alternatives for LANL would have no adverse impact on the geological resources described in section 4.6.2.5. Although a moderate seismic risk exists at LANL, this would be considered during design, construction, and operation of any new functions. The existing seismic risk does not preclude safe implementation and operation of the new functions. The LANL stockpile management alternatives and the proposed Atlas Facility would use existing structures within their current footprints. There would be a nominal amount of area required for equipment staging, material

laydown, and parking. Existing facility space or developed areas would be used for these activities. Modification activities, with the exception of the erection of seismic reinforcement, would be within the existing building structures. There is sufficient parking for construction workers in lots adjacent to work areas.

The proposed NIF would require additional acreage, but would not adversely affect geological resources. Control measures would be used to minimize any soil erosion. Potential changes to geology and soils associated with the proposed alternatives at LANL are discussed below.

No Action. Under No Action, DOE would continue current and planned activities at LANL. Any impacts to geology and soils would be independent of and unaffected by the proposed action.

Management Alternatives

Pit Fabrication. All new functions would be accommodated within existing structures; therefore, modification and operation activities would not affect geological conditions. Soil disturbance is not expected. The properties and conditions of the soils underlying the proposed site place no limitations on modification activities and operation. Soils would not adversely affect the safe operation of project facilities.

During implementation and operation of the new functions, seismic activity in the area could pose a potential hazard to the facilities and personnel at LANL. Modifications of site facilities to accommodate new pit fabrication functions would take into account the moderate seismic risk in the LANL area. All facilities would be designed for earthquake-generated ground acceleration in accordance with DOE O 420.1 and accompanying safety guides. Secondary effects from seismic activities, such as soil liquefaction or landslides, are not expected because of the depth of groundwater and relatively stable topography on top of the mesas. Hazards resulting from the return of volcanism during implementation or operation are unlikely (see section 4.6.2.5). Potential health impacts from accidents associated with geological hazards are discussed in section 4.6.3.9.

Secondary and Case Fabrication. Impacts to geology and soils from secondary and case fabrication at LANL would be similar to those described above for pit fabrication.

High Explosives Fabrication. Impacts to geology and soils from HE fabrication at LANL would be similar to those described above for pit fabrication.

Nonnuclear Fabrication. Impacts to geology and soils from nonnuclear fabrication at LANL would be similar to those described above for pit fabrication.

Sensitivity Analysis . The high or low case operation scenario for the proposed stockpile management alternatives at LANL would not affect geology or soils.

Stewardship Alternatives

Proposed National Ignition Facility. The construction and operation of the proposed NIF at LANL would not adversely affect geological resources. NIF would require the clearing of an estimated 4 ha (10 acres) of land for buildings, walkways, building access, and buffer space. Soil impacts during construction would be short term and minor with appropriate erosion and sediment control measures. Net soil disturbance during operation would be less than for construction because areas temporarily

used for equipment and material laydown would be restored. Seismic risks would be taken into account during construction and operation of the proposed NIF (see appendix I).

Proposed Atlas Facility. The design, installation, and operation of the Atlas Facility in existing buildings at LANL would have no impact on geological resources. Seismic risks would be taken into account during design, implementation, and operation of the Atlas Facility (see appendix K).

Potential Mitigation Measures. No mitigation measures for stockpile stewardship and management alternatives at LANL are anticipated.

4.6.3.6 Biotic Resources

The following sections address impacts to terrestrial resources, wetlands, aquatic resources, and threatened and endangered species at LANL. Although most alternatives would not impact these resources, the proposed NIF would result in a loss of terrestrial habitat and possible impacts to threatened and endangered species.

No Action. Under No Action, the limited replacement pit fabrication, selected nonnuclear fabrication, and stewardship R&D missions described in section 3.2.6 would continue at LANL. There would be no changes to current biotic resource conditions at the site as described in section 4.6.2.6.

Management Alternatives

Pit Fabrication. The pit fabrication and intrusive and nonintrusive modification pit reuse mission at LANL would utilize existing facilities within the boundaries of a number of the site's TAs. No new construction would be required and wastewater would be released through existing NPDES-permitted discharges. The operation of pit manufacturing facilities at LANL is not expected to impact biotic resources.

Secondary and Case Fabrication. The secondary and case fabrication mission, would take place in existing structures located within a number of the site's TAs. No new construction would be required and wastewater would be released through existing NPDES permitted discharges. The operation of the secondary and case fabrication mission facilities at LANL is not expected to impact biotic resources.

High Explosives Fabrication. The HE fabrication mission would take place in existing structures located within a number of the site's TAs. No new construction would be required and wastewater would be released through existing NPDES-permitted discharges. The operation of HE fabrication mission facilities at LANL is not expected to impact biotic resources.

Nonnuclear Fabrication. Nonnuclear fabrication mission elements that would be moved to LANL would be located in existing buildings within a number of the site's TAs. No new construction would be required and wastewater would be released through existing NPDES-permitted discharges. The relocation of the nonnuclear fabrication mission to LANL is not expected to impact biotic resources.

Sensitivity Analysis. Implementation of either a low or high case workload for the stockpile management alternatives would not affect biological resources at LANL.

Stewardship Alternatives

Proposed National Ignition Facility

Terrestrial Resources. The proposed NIF would be located within TA-58, an undeveloped area containing ponderosa pine. Construction of new facilities would result in the disturbance of approximately 4 ha (10 acres) of habitat. This would cause a fragmentation of the wooded habitat present on the site. Proper erosion and sediment control measures would reduce the potential for disturbance of habitat adjacent to the construction area. During construction, animal species within the disturbed area would be either destroyed or displaced depending upon whether they were able to move from the area.

During construction and operation, fencing around the proposed NIF could cause a localized constraint on the movement of the resident elk herd in the area of the site. Wildlife may also be disturbed by the increased level of human activity associated with the project.

Wetlands. Construction and operation of the proposed NIF is not expected to affect wetlands since this resource is not located on or near the proposed site.

Aquatic Resources. Construction and operation of the proposed NIF is not expected to affect aquatic resources since this resource is not located on or near the proposed site.

Threatened and Endangered Species. The construction of the proposed NIF at LANL would disturb a small amount of habitat suitable for several special status species which potentially exist onsite. If present, less mobile species such as the New Mexican meadow jumping mouse *(Zapus hudsonius luteus)* and plant species could be lost during construction. Construction could also disturb potential foraging or nesting habitat for the Mexican spotted owl (Strix occidentalis lucida), gray vireo *(Vireo vicinior)* , southwestern willow flycatcher *(Empidonox traillii extimus)* , and spotted bat *(Euderma maculata)* . Some species such as the spotted owl may be further disturbed by the increased level of human activity (i.e., noise and lighting) associated with the project. Informal consultation under the Endangered Species Act may be necessary regarding the Mexican spotted owl.

Proposed Atlas Facility. The proposed Atlas Facility would be located at TA-35, located near the center of Pajarito Mesa, which is immediately north and east of Pajarito Canyon. The facility would be placed in existing TA-35 buildings, with the exception of a limited number of associated structures (e.g., storage tanks and a concrete pad), which would be constructed adjacent to existing buildings. No natural habitat would be disturbed and runoff volumes would not change appreciably from present levels; thus, impacts to biotic resources from construction and operation of the proposed Atlas Facility would not be expected.

Potential Mitigation Measures. Limiting the area to be disturbed, revegetating with native species, and implementing a soil erosion and sediment control plan would help to lessen short- and long-term impacts to terrestrial species and habitats. Disturbance to wildlife living in areas adjacent to new facilities may be minimized by preventing workers from entering undisturbed areas. It may be necessary to survey the site for the nests of migratory birds prior to construction and to avoid clearing operations during the breeding season. If any threatened or endangered species exist on the site, specific mitigation measures would be developed in conjunction with the USFWS.

4.6.3.7 Cultural and Paleontological Resources

For the discussion of impacts, the term cultural resources includes prehistoric, historic, and Native American resources. Cultural and paleontological resources may be affected directly through ground disturbance, building modification, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism. Cultural resources surveys have been conducted in portions of the involved TAs. Some NRHP-eligible prehistoric and historic resources may be affected by the proposed actions. Site-specific surveys and evaluations would be conducted in conjunction with the *National Historic Preservation Act* and tiered NEPA documents. No impacts to Native American resources are anticipated. Geological strata at LANL are not known to be fossiliferous.

No Action. Under No Action, DOE would continue existing and planned missions at LANL as described in section 3.2.6. Any impacts to cultural or paleontological resources would be independent of and unaffected by the proposed action.

Management Alternatives

Pit Fabrication. Pit fabrication and intrusive modification pit reuse would necessitate reconfiguring and upgrading existing facilities within TAs -3, -8, -35, -50, -54, and -55. A nominal area would be required for equipment staging, material laydown, and parking during the modification of the facilities. All of TA-35 has been surveyed, and no cultural resources were identified. Portions of TAs -3, -8, -50, -54, and -55 have been surveyed and contain NRHP-eligible prehistoric and/or historic resources. Additional prehistoric and historic resources may exist on unsurveyed portions of the involved TAs. NRHP-eligible resources would be identified through project-specific inventories and evaluations, and any project-related effects would be addressed in tiered NEPA documentation. Impacts to Native American resources are not expected as a result of the alternative but would be identified through consultation with the potentially affected tribes. None of the geological formations at LANL are known to be fossiliferous.

Secondary and Case Fabrication. Replacing secondary and case fabrication would use existing facilities within the boundaries of TAs -3, -8, -50, -54, and -55. Some of these buildings would need modifications. A nominal area within existing buildings and developed areas would be required for equipment staging, material laydown, and parking during the facilities modification. Portions of each of the involved TAs have been surveyed and contain NRHP-eligible prehistoric and/or historic resources. Some additional NRHP-eligible sites may exist in unsurveyed portions of the involved TAs. Some prehistoric and historic resources may be affected by the proposed action. NRHP-eligible resources would be identified through project-specific surveys, inventories, and evaluations, and any project-related effects would be addressed in tiered NEPA documentation. Impacts to Native American resources are not expected but would be identified through consultation with potentially affected tribes. None of the geological formations at LANL are known to be fossiliferous.

High Explosives Fabrication. HE fabrication would take place in TAs -9, -16, -28, and -37. Only minimal new equipment is needed; no facility construction or modification is necessary to conduct the HE fabrication mission at LANL. No impacts to cultural or paleontological resources are anticipated. Sharing this mission with LLNL would have no impact on cultural and paleontological resources at LANL.

Nonnuclear Fabrication. Nonnuclear fabrication would use existing facilities within TAs -3, -16, -22, and -35. Additional equipment and building modifications would be necessary. These modifications largely involve electrical upgrades, and no ground disturbance is expected. Impacts to prehistoric, Native American, or paleontological resources are not anticipated. Some of the facilities to be modified under this alternative have been declared eligible for inclusion in the NRHP. Any project-related effects to historic resources would be addressed in tiered NEPA and *National Historic Preservation Act* documentation.

Sensitivity Analysis. The high and low case scenarios for the proposed stockpile management alternatives at LANL would have the same impacts to cultural and paleontological resources as the base case production facilities.

Stewardship Alternatives

Proposed National Ignition Facility. Surveys indicate that no prehistoric or historic archaeological sites or structures exist on the proposed NIF location in TA-58. Paleontological remains are unlikely to exist in the proposed location because the Pajarito Plateau, comprised of Pleistocene volcanic tuffs and the Bandelier Formation, does not contain fossiliferous deposits. No Native American resources have been identified to date in the proposed location but some may be identified through consultation with the potentially affected tribes.

Proposed Atlas Facility. Existing buildings in TA-35 would be renovated to implement the proposed Atlas Facility. Some additional land would be required for the placement of concrete pads, storage tanks, and transportable office and diagnostic space. All of TA-35 has been surveyed for cultural resources and none were identified. All of the involved buildings were constructed in either 1980 or 1990 (appendix K) and are not NRHP eligible. No impacts to Native American or paleontological resources are expected.

Potential Mitigation Measures. If NRHP-eligible sites cannot be avoided though project design or siting, and the facility would cause adverse impacts, then a Memorandum of Agreement would need to be negotiated among DOE, the New Mexico SHPO, and the Advisory Council on Historic Preservation. The Memorandum of Agreement would formalize mitigation measures agreed to by these consulting parties. Mitigation measures could include describing and implementing intensive inventory and evaluation studies, data recovery plans, site treatments, and monitoring programs. The appropriate level of data recovery for mitigation would be determined through consultation with the New Mexico SHPO and the Advisory Council on Historic Preservation in accordance with Section 106 of the *National Historic Preservation Act* . Mitigation measures for specific NRHP-eligible sites would be identified during tiered NEPA documentation.

If Native American resources could not be avoided through project design or siting, then acceptable mitigation measures to reduce project impacts on them would be determined in consultation with the affected Native American groups. In accordance with the Native American Graves Protection and Repatriation Act and the American Indian Religious Freedom Act, such mitigations may include, but would not be limited to, appropriately relocating human remains, planting vegetation screens to reduce visual or noise intrusion, increasing access to traditional use areas during operation, or transplanting or harvesting important Native American plant resources.

4.6.3.8 Socioeconomics

No Action. Under No Action, the existing missions at LANL as described in section 3.2.6 would continue with no new employment or in-migration of workers. Projections for regional economy and employment rates, population and housing changes, and public finance characteristics are presented in appendix D.

By 2002, the DAHRT Facility would be operational at LANL. A total of 80 jobs would be generated as a result of operation of this facility. This increase in workers has been considered in the No Action analysis for LANL.

Regional Economy and Employment. Total employment in the regional economic area is projected to grow slightly less than 2 percent annually between 1995 and 2000, reaching approximately 122,700 in the latter year. Long-range projections show employment growth averaging slightly more than 1 percent annually between 1995 and 2000 and then slowing to less than 1 percent between 2021 and 2030, reaching approximately 164,400 persons. Site employment at LANL is expected to total 6,546 in 2005. The unemployment rate in the regional economic area was 6.2 percent in 1994 and is expected to remain at this level into the near future. Per capita income is projected to increase from approximately $18,314 in 1995 to $26,801 in 2030.

Population and Housing. Annual ROI county and city population and housing growth is projected to be less than 2 percent over the period 1995 to 2005 and then is expected to slow to about 1 percent in the period 2006 to 2030. Annual increases between 2006 and 2030 are expected to be a little more than 1 percent. Population in the ROI is projected to increase from 167,400 in 1995 to 245,100 by 2030. The total number of housing units in the ROI is projected to increase from 70,100 in 1995 to 102,700 in 2030.

Public Finance. Between 2000 and 2005, all ROI county, city, and school district total revenues are projected to increase at an annual average of less than 1.6 percent. Total expenditures are projected to increase at an annual average of less than 1.5 percent during the same period. These rates of increase should continue until 2030.

Management Alternatives

Pit Fabrication

Regional Economy and Employment. Modification-related activities for the Pit Fabrication Facility would require 138 direct workers during the peak construction year and would generate approximately an additional 90 indirect jobs in the regional economic area. As a result of the modification activities, total employment for the LANL regional economic area would increase by much less than 1 percent. This increase would reduce the unemployment rate from 6.2 percent under the No Action alternative to approximately 6 percent. Per capita income for the LANL regional economic area would increase very slightly over No Action projections.

Operation employment at LANL would begin phasing in as the modification phase nears completion. Operation of the facility in the base case surge mode would generate 260 new direct jobs, but would generate no indirect jobs because there are no closely related industries in the regional economic area. As a result of the operation of the facility, total employment for the LANL regional economic area would increase by much less than 1 percent. This increase would reduce regional unemployment from the 6.2 percent No Action estimate to approximately 6.0 percent. Per capita income for the LANL

regional economic area would increase by much less than 1 percent over No Action projections. Changes in employment and per capita income resulting from the operation of the Pit Fabrication Facility are shown in figure 4.6.3.8-1.

Population and Housing. Population in the LANL ROI during peak construction would not increase over No Action projections. Available workers in the regional economic area and ROI would be sufficient to fill all of the direct and indirect jobs generated by the modification activities for the facility.

There would not be enough available workers to fill all of the direct operation jobs. Approximately 20 workers would in-migrate to fill positions at the Pit Fabrication Facility. The ROI population over No Action for full operation at LANL is shown in figure 4.6.3.8-2. Vacant housing in the ROI is sufficient to house the in-migrating workers and their families.

Public Finance. Modification of the Pit Fabrication Facility would not require in-migrating workers. Therefore, changes to local finances compared to No Action projections would be attributed to income increases and would be negligible.

Changes in revenues and expenditures compared to No Action projections due to operation of the facility at LANL are shown in figure 4.6.3.8-3. In 2005 the percent increase in total ROI revenues and expenditures over No Action projections would be negligible with the exception of the Los Alamos school district which would be expected to experience increases of approximately 1 percent.

Secondary and Case Fabrication

Regional Economy and Employment. Modification-related activities for the Secondary and Case Fabrication Facility would generate a total of 55 direct jobs during the peak construction year and would generate an additional 36 indirect jobs in the regional economic area. As a result of the modification activities, total employment for the LANL regional economic area would increase by less than 1 percent. This increase would reduce regional unemployment from the 6.2 percent No Action estimate to approximately 6.1 percent. Per capita income for the LANL regional economic area would increase very slightly over No Action projections as a result of modification activities for the Secondary and Case Fabrication Facility.

Facility operation-related employment at LANL would begin phasing in as the modification phase nears completion. Operation of the facility in the base case surge mode would require 321 new direct workers but would generate few additional indirect jobs in the regional economic area because there are no closely related industries in the regional economic area. As a result of the operation of the facility, total employment for the LANL regional economic area would increase by less than 1 percent. This increase would reduce regional unemployment from the 6.2 percent No Action estimates to approximately 6.0 percent. Per capita income for the LANL regional economic area would increase by less than 1 percent over No Action projections. Changes in employment and per capita income resulting from the operation of the Secondary and Case Fabrication Facility are shown in figure 4.6.3.8-1.

Population and Housing. Population in the LANL ROI during construction or operation of the Secondary and Case Fabrication Facility would not increase over No Action projections. Available workers in the regional economic area and ROI would be sufficient to fill all of the jobs generated by construction and operation of the facility.

Public Finance. Construction and operation of the Secondary and Case Fabrication Facility would not require in-migrating workers. Therefore, changes to local finances compared to No Action projections would be due to income increases and would be negligible.

High Explosives Fabrication

Regional Economy and Employment. Modification-related activities for the facility would require 46 direct workers during the peak construction year and would generate an additional 30 indirect jobs in the regional economic area. As a result of the modification activities, total employment for the LANL regional economic area would increase by less than 1 percent. Unemployment would decrease from the 6.2 percent No Action estimates to approximately 6.1 percent. Per capita income for the LANL regional economic area would increase very slightly over No Action projections as a result of modification activities for the HE Facility.

Facility operation-related employment at LANL would begin phasing in as the modification phase nears completion. Operation of the facility in the base case surge mode would require 67 new direct workers but would generate only a few indirect jobs because there are no closely related industries in the regional economic area. As a result of the operation of the HE Facility, total employment for the LANL regional economic area would increase by much less than 1 percent. The No Action regional unemployment of 6.2 percent would decrease to 6.1 percent. Per capita income for the LANL regional economic area would increase slightly over No Action projections. Changes in employment and per capita income resulting from the operation of the HE Facility are shown in figure 4.6.3.8-1.

Population and Housing. Population in the LANL ROI during peak construction would not increase over No Action projections. Available workers in the regional economic area and ROI would be sufficient to fill all of the direct and indirect jobs generated by construction of the HE Facility.

There would not be enough available workers in the regional economic area and ROI to fill all of the jobs generated by operation of the facility. Approximately 10 additional workers would have to in-migrate into the ROI to fill the new direct jobs. Population in the LANL ROI during full operation would increase by approximately 30 people over No Action projections. The ROI population over No Action for full operation at LANL is shown in figure 4.6.3.8-2. No additional housing units would be needed to meet such a small population increase.

Public Finance. Modification of the HE Facility would not require in-migrating workers. Therefore, changes to local finances compared to No Action projections would be due to income increases and would be negligible.

Changes in revenues and expenditures compared to No Action projections due to operation of the HE Facility at LANL are shown in figure 4.6.3.8-4. In 2005, the percent increase in total ROI revenues and expenditures over No Action projections would be negligible.

Nonnuclear Fabrication

Regional Economy and Employment. Modification-related activities for the facility would require a total of six workers during the peak construction year and would generate an additional four indirect jobs in the regional economic area. As a result of the modification activities, total employment and per capita income would not noticeably increase. The unemployment rate would remain unchanged.

Facility operation-related employment at LANL would begin phasing in as the modification phase nears completion. Operation of the facility in the base case surge mode would require 194 new direct workers and would generate approximately 46 indirect jobs in the regional economic area. As a result of the operation of the facility, total employment for the LANL regional economic area would increase by less than 1 percent. Unemployment would decrease from 6.2 percent under the No Action alternative to 6.0 percent. Per capita income for the LANL regional economic area would increase by less than 1 percent over No Action projections. Changes in employment and per capita income resulting from the operation of the Nonnuclear Fabrication Facility are shown in figure 4.6.3.8-1.

Population and Housing. Population in the LANL ROI during peak construction and full operation would not increase over No Action projections. There would be enough workers available in the regional economic area and ROI to fill all of the direct and indirect jobs generated by the modification and operation of the Nonnuclear Fabrication Facility.

Public Finance. Construction and operation of the Nonnuclear Fabrication Facility would not require in-migrating workers. Therefore, changes to local finances compared to No Action projections would be due to income increases and would be negligible.

Partial Nonnuclear Fabrication. LANL may not receive the entire nonnuclear mission. Reservoirs and/or plastics may be excluded from the mission. If this occurs, the full operation employment increment would range from 57 to 232 direct jobs. For these options, in-migration would not be required. Socioeconomic effects on regional economy, employment, population, and housing would be less than for the full nonnuclear mission. These changes would be minimal.

Sensitivity Analysis . There would be no change in the number of construction workers required to complete any of the facilities for LANL (pit manufacturing, secondary and case fabrication, HE or nonnuclear fabrication) for either the high or low case. Operation of any of the facilities for the high case level would require fewer workers than would the base case surge operation. For the low case, worker requirements would decrease further causing slightly smaller increases in regional economy, population and housing, and public finance than occurred in either the base case surge or high case levels. These changes would be negligible.

Stewardship Alternatives

Proposed National Ignition Facility. The following is a summary of the socioeconomic effects of construction of the proposed NIF at LANL. See appendix I for a more detailed, project-specific discussion.

Regional Economy and Employment. Construction of NIF would require 270 construction workers during the peak year of construction and would generate approximately 860 additional indirect jobs in the regional economic area. Employment for operation would begin phasing in as the construction phase nears completion. Operation of the facility would require 330 direct workers and would generate 270 additional indirect jobs in the regional economic area. Construction and operation of NIF would have only minimal affects on the regional economy and employment.

Population and Housing. Both construction and operation of the facility would require workers and their families to in-migrate to the ROI. This in-migration would cause a slight increase in the population of the ROI. Vacant housing in the ROI is sufficient to handle these increases.

Public Finance. Both revenues and expenditures would increase as a result of the construction and operation of NIF. Increases due to construction would peak in 1998 and then decline as construction nears completion in 2002. Increases due to operation of the facility would peak in 2003 and continue through the duration of NIF operations.

Proposed Atlas Facility. The Atlas Facility at LANL would not have any identified socioeconomic impact over No Action.

Combined Program Impacts. If the pit fabrication, secondary and case fabrication, HE, and nonnuclear fabrication missions and the NIF were all located at LANL, the resulting benefits to the regional economy would be greater than from any one mission. Increases in total employment would be about 1 percent while per capita income would increase less than 1 percent. There would be sufficient available labor in the projected labor force to fill any construction-related employment requirements, but not enough to fill operation-related employment requirements. Approximately 1,349 people (workers and their families) would in-migrate into the LANL ROI to fill the available operation jobs. Although there would be a small population increase in the ROI, vacant housing would not be sufficient to house all in-migrating workers during full operation. Approximately 250 houses would need to be constructed over the No Action estimates. However, based on past building rates, new construction would be able to meet this demand. As shown in figure 4.6.3.8-5, the increase in ROI total revenues and expenditures over No Action projections would be approximately 0.7 and 0.6 percent, respectively. The Los Alamos School District would experience the greatest revenue and expenditure increases at approximately 3.1 percent.

Potential Mitigation Measures. No mitigation measures are anticipated for the stockpile stewardship and management alternatives at LANL.

4.6.3.9 Radiation and Hazardous Chemical Environment

This section describes the radiological and hazardous chemical releases and their associated impacts which could result from No Action and proposed alternatives at LANL. Within this section, impacts resulting from the base case scenario are quantitatively discussed, and a sensitivity analysis of the high and low case scenarios is qualitatively discussed.

Summaries of the prevailing radiological impacts at LANL to the public and to workers associated with normal operation are presented in tables 4.6.3.9-1 and 4.6.3.9-2, respectively; accident radiological impacts are presented in figure 4.6.3.9-1 and tables 4.6.3.9-3 through 4.6.3.9-7. The impact assessment methodology is described in section 4.1.9, and further supplementary methodological information is presented in appendixes E and F.

Normal Operation There would be no radiological releases during the construction or modification of any facilities to support the Stockpile Stewardship and Management Program. However, limited hazardous chemical releases (e.g., small spills of diesel fuel from equipment refueling) may occur due to construction activities for the base case scenario and may increase slightly for the high case scenario. The concentration of these releases is expected to be well within the regulated exposure limits and would not result in any adverse health effects.

Water from processes containing hazardous chemicals is not discharged directly into surface water or groundwater that serves as potable water. Process water that may contain hazardous chemicals is

treated before discharge. Furthermore, discharges of wastewater through NPDES-permitted outfalls which can be attributed to the activities associated with normal operations and operations of the stockpile stewardship and management alternatives at LANL are expected to be below NPDES limits. Water quality would not be adversely affected. Thus, the primary pathway considered for the public and the onsite worker is the air pathway.

For normal operation at LANL, all possible hazardous chemicals were examined for further analysis based on their toxicity, concentration, and frequency of use. The HI is a summation of the HQ for all chemicals. The HQ is the value used as an assessment of noncancer toxic effects of chemicals (e.g., kidney or liver dysfunction). It is independent of cancer risk, which is calculated only for those chemicals identified as carcinogens. The HI was calculated for the No Action chemicals and all alternative chemicals proposed to be added (the increment) at the site to yield cumulative levels for the site. An HI of 1.0 indicates that all noncancer exposure values meet OSHA standards; if the cancer risk is 1x10-*6* (the default value, not a regulatory standard), no further analysis is indicated. A cancer risk of 1x10-*6* is considered acceptable by EPA (40 CFR 300.430) because this incidence of cancers cannot be distinguished from the cancer risk for an individual member of the population. Information pertaining to OSHA-regulated exposure limits and toxicity profiles for all hazardous chemicals described in this PEIS may be found in the *Chemical Health Effects Technical Reference* (TTI 1996b).

No Action

Radiological Impacts. Radiological impacts to the public resulting from the No Action alternative are presented in table 4.6.3.9-1. These impacts are representative of the aggregated total which is estimated to exist from all future baseline operational contributions (including pit fabrication R&D). Total impacts are provided to compare with applicable regulations governing total site operations. To place doses to the public from the No Action alternative into perspective, comparisons are made to natural background radiation. As shown in table 4.6.3.9-1, the total dose to the maximally exposed member of the public from annual total site operations is within radiological limits and would be 6.5 mrem for the No Action alternative. The annual population dose within 80 km (50 mi) in 2030 would be 2.7 person-rem.

Total site doses to onsite workers from normal operation for the No Action alternative are presented in table 4.6.3.9-2. The estimated annual dose to the entire facility workforce for this alternative would be 196 person-rem. The presented noninvolved worker impacts were not modeled due to the unavailability of certain site-specific information.

Potential radiological impacts to the public and workers in tables 4.6.3.9-1 and 4.6.3.9-2 include the addition of the phased containment option (preferred alternative) representing the DARHT Facility and the phaseout of the PHERMEX Facility at LANL. Based on the radiological impacts associated with normal operation under the No Action alternative, all resulting doses would be within radiological limits and are well below levels of natural background radiation. The associated risks of adverse health effects to the public and to workers would be small.

Hazardous Chemical Impacts. Hazardous chemical impacts to the public resulting from normal operation under No Action at LANL are presented below. Analyses to support the values presented in this section are provided in appendix table E.3.4-13. This PEIS does not purport to provide the level of detail needed to go beyond a conservative screening process for hazardous chemicals. As such, the analysis in this PEIS for the No Action alternative should not be relied upon as a basis for judging the

sites as having a hazardous health concern of alternatives among sites. The model used to calculate HI and cancer risk in this PEIS only establishes a baseline for comparison of alternatives among sites. The baseline is then used to determine the extent to which each alternative adds or subtracts from the No Action HI and cancer risk to the public at each site.

The HI for the maximally exposed individual of the public at LANL resulting from normal operation under the No Action alternative would be $3.01x10^{-2}$, and the cancer risk would be $5.15x10^{-6}$. The HI for the onsite worker would be $4.65x10^{-2}$ and the cancer risk would be $1.54x10^{-4}$. The HIs for the public and onsite worker are within acceptable health levels.

Cancer risks to the public and to the onsite worker exceed the EPA default value as a result of the emissions of methylene chloride; 1,1,2-trichloroethane; and trichloroethylene associated with operations under the No Action alternative at LANL.

Mitigation measures such as substituting less toxic solvents or modifying processes are proposed to reduce or eliminate the emissions of all hazardous chemicals due to operations under the No Action alternative with particular attention to methylene chloride; 1,1,2-trichloroethane; and trichloroethylene.

Table 4.6.3.9-1.-- Potential Radiological Impacts to the Public Resulting from Normal Operation of Stockpile Stewardship and Management Alternatives at Los Alamos National Laboratory

	No Action	Pit Fabrication Three-Shift Operation	Secondary and Case Fabrication Three-Shift Operation[9]	National Ignition Facility	Atlas Facility	Combined Program Total[10]
Affected Environment	**Total Site**	**Total Site[11]**	**Total Site[11]**	**Total Site[11]**	**Total Site[11]**	**Total Site[11]**
Maximally Exposed Individual (Public)						
Atmospheric Release						
Dose[12] (mrem/yr)	5.7	5.7	5.9	5.7	5.7	5.9
Percent of natural background[13]	1.7	1.7	1.7	1.7	1.7	1.7
25-year fatal cancer risk	$7.1x10^{-5}$	$7.1x10^{-5}$	$7.4x10^{-5}$	$7.1x10^{-5}$	$7.1x10^{-5}$	$7.4x10^{-5}$
Liquid Release						

Dose[12] (mrem/yr)	0.80	0.80	0.80	0.80	0.80	0.80
Percent of natural background[13]	0.24	0.24	0.24	0.24	0.24	0.24
25-year fatal cancer risk	$1.0x10^{-5}$	$1.0x10^{-5}$	$1.0x10^{-5}$	$1.0x10^{-5}$	$1.0x10^{-5}$	$1.0x10^{-5}$
Atmospheric and Liquid Releases						
Dose[12] (mrem/yr)	6.5	6.5	6.7	6.5	6.5	6.7
Percent of natural background[13]	1.9	1.9	2.0	1.9	1.9	2.0
25-year fatal cancer risk	$8.1x10^{-5}$	$8.1x10^{-5}$	$8.4x10^{-5}$	$8.1x10^{-5}$	$8.1x10^{-5}$	$8.4x10^{-5}$
Population Within 80 Kilometers						
Atmospheric and Liquid Releases in 2030						
Dose (person-rem)	2.7	2.7	3.2	2.8	2.7	3.3
Percent of natural background[13]	$2.8x10^{-3}$	$2.8x10^{-3}$	$3.4x10^{-3}$	$2.9x10^{-3}$	$2.8x10^{-3}$	$3.5x10^{-3}$
25-year fatal cancers	0.034	0.034	0.040	0.035	0.034	0.041

Table 4.6.3.9-2.-- Potential Radiological Impacts to Workers Resulting from Normal Operation of Stockpile Stewardship and Management Alternatives at Los Alamos National Laboratory

Affected Environment	No Action	Pit Fabrication Three-Shift Operation	Secondary and Case Fabrication Three-Shift Operation[14]	National Ignition Facility	Atlas Facility	Combined Program Total
Involved Workforce[15]						
Average worker dose[16] (mrem/yr)	NA	380	2.2	30	0	NA

25-year fatal cancer risk	NA	$3.8x10^{-3}$	$2.2x10^{-5}$	$3.0x10^{-4}$	0	NA
Total dose (person-rem/yr)	NA	55.6	0.33	8.0	0	64
Noninvolved Workforce [17]						
Average worker dose[16] (mrem/yr)	34	34	34	34	34	NA
25-year fatal cancer risk	$3.4x10^{-4}$	$3.4x10^{-4}$	$3.4x10^{-4}$	$3.4x10^{-4}$	$3.4x10^{-4}$	NA
Total dose (person-rem/yr)	196	196	196	196	196	196
Total Site Workforce[18]						
Dose (person-rem/yr)	196	252	196	204	196	260
25-year fatal cancers	2.0	2.5	2.0	2.0	2.0	2.6

Management Alternatives

Pit Fabrication

Radiological Impacts. Radiological impacts to the public resulting from the pit fabrication alternative are presented in table 4.6.3.9-1. These impacts are representative of the aggregate total which is estimated to exist from all future baseline operational LANL contributions and from three-shift base case operations for pit fabrication at the site. Total impacts are provided to compare with applicable regulations governing total site operations. To place doses to the public from this alternative into perspective, comparisons are made to natural background radiation. As shown in table 4.6.3.9-1, the total dose to the maximally exposed member of the public from annual total site operations is within radiological limits and would be 6.5 mrem for this alternative. The annual population dose within 80 km (50 mi) in 2030 would be 2.7 person-rem. The impacts incurred from three-shift base case operations are negligible when compared to those existing for the normal baseline site operations (see table 4.6.3.9-1).

Total site doses to onsite workers from normal operation for the pit fabrication mission are presented in table 4.6.3.9-2. The average annual dose to involved workers for this alternative would be 380 mrem. The dose to the entire facility workforce (involved workforce) would be 55.6 person-rem. As stated in the methodology section 4.1.9, all worker doses were referenced either from alternative-specific working group data reports or from the Radiation Exposures for DOE and DOE Contractor Employees 1992 Database which reports doses for similar types of operations. The presented noninvolved worker impacts were not modeled due to the unavailability of certain site-specific information. There may also be small risks to construction workers who are involved with tasks that are in close proximity to potentially contaminated areas.

Hazardous Chemical Impacts. Hazardous chemical impacts for the public and for the onsite worker resulting from normal operation of the pit fabrication alternative at LANL are presented below. The pit fabrication alternative includes intrusive and nonintrusive modification pit reuse. The HI and cancer risk would remain constant over 25 years of operation provided exposures remain the same. Analyses to support the values presented in this section are provided in appendix table E.3.4-14.

The incremental HI for the maximally exposed member of the public would be $2.10x10^{-4}$, and the incremental cancer risk would be zero as a result of operation of the pit fabrication mission in the year 2005. The incremental HI for the onsite worker would be $1.75x10^{-4}$, and the incremental cancer risk would be zero as a result of operation of the pit fabrication mission in 2005.

The total site operation and the increment associated with the pit fabrication alternative would result in HIs for the public (0.030) and onsite worker (0.047) that are within acceptable health levels. The cancer risks to the public ($5.15x10^{-6}$) and to the onsite worker ($1.54x10^{-4}$) slightly exceed the EPA default value of $1x10^{-6}$.

Cancer risks to the public and to the onsite worker exceed the EPA default value as a result of the No Action emissions of chloroform; methylene chloride; 1,1,2-trichloroethane; and trichloroethylene. Incremental emissions due to the pit fabrication mission cause only a minimal increase in the HI for the public and onsite worker and, therefore, this alternative is not expected to increase the cancer risk for the public and the onsite worker.

Secondary and Case Fabrication

Radiological Impacts. Radiological impacts for the public resulting from the secondary and case fabrication alternative are presented in table 4.6.3.9-1. These impacts are representative of the aggregate total which is estimated to exist from all future baseline operational LANL contributions and from three-shift base case operation for secondary and case fabrication at the site. Total impacts are provided to compare with applicable regulations governing total site operations. To place doses for the public from this alternative into perspective, comparisons are made to natural background radiation. As shown in table 4.6.3.9-1, the total dose to the maximally exposed member of the public from annual total site operations is within radiological limits and would be 6.7 mrem for this alternative. The annual population dose within 80 km (50 mi) in 2030 would be 3.2 person-rem. The impacts incurred from three-shift base case operations are small when compared to those existing for the normal baseline site operations (see No Action column in table 4.6.3.9-1).

Total site doses to onsite workers from normal operation for the secondary and case fabrication mission are presented in table 4.6.3.9-2. The average annual dose to involved workers for this alternative would be 2.2 mrem. The dose to the entire facility workforce (involved workforce) would be 0.33 person-rem. As stated in the methodology section 4.1.9, all worker doses were referenced from the Radiation Exposures for DOE and DOE Contractor Employees 1992 Database which reports doses for similar types of operations. The presented noninvolved worker impacts were not modeled due to the unavailability of certain site-specific information. There may also be small risks to construction workers who are involved with tasks that are in close proximity to potentially contaminated areas.

Hazardous Chemical Impacts. Hazardous chemical impacts for the public and for the onsite worker

resulting from the normal operation of the secondary and case fabrication alternative at LANL are presented below. The HI and cancer risk would remain constant over 25 years of operation provided exposures remain the same. Analyses to support the values presented in this section are provided in appendix table E.3.4-15.

The incremental HI for the maximally exposed member of the public would be 9.43x10-4 and the incremental cancer risk would be zero as a result of operation of the secondary and case fabrication mission in 2005. The incremental HI for the onsite worker would be 7.89x10-4 and the incremental cancer risk would be zero as a result of operation of the secondary and case fabrication mission in 2005.

Total site operations of the secondary and case fabrication mission would result in HIs (HI is applicable only to noncarcinogenic risks) for the public (0.031) and the onsite worker (0.047) that are within acceptable health levels. The cancer risks for the public (5.15×10^{-6}) and the onsite worker (1.54×10^{-4}) slightly exceed the EPA default value of 1x10-6using extremely conservative stack assumptions (i.e., a stack flow of 0.1 ft/sec). Using the same emissions values and average LANL stack flow, the cancer risk values drop by 2 to 3 orders of magnitude (i.e., 100 to 1,000 times lower).

Cancer risks for the public and for the onsite worker exceed the EPA default value as a result of the No Action emissions of methylene chloride; 1,1,2-trichloroethane; and trichloroethylene. When average LANL stack flows are used, the cancer risk for the public and the onsite worker do not exceed the default value for any alternative. Incremental emissions due to the secondary and case fabrication mission cause only a minimal increase in HI (noncarcinogenic risks) for the public and onsite worker and no additional cancer risk for the public and the onsite worker.

High Explosives Fabrication

Radiological Impacts. There are no radiological impacts associated with this alternative.

Hazardous Chemical Impacts. Hazardous chemical impacts for the public and for the onsite worker resulting from normal operation of the HE fabrication alternative at LANL are presented below. The HI and cancer risk would remain constant over 25 years of operation provided exposures remain the same. Analyses to support the values presented in this section are provided in appendix table E.3.4-16.

The incremental HI for the maximally exposed individual of the public would be 3.99x10-3 and the incremental cancer risk would be zero as a result of operation of the HE fabrication mission in 2005. The incremental HI for the onsite worker would be 3.33×10^{-3} and the incremental cancer risk would be zero as a result of operation of the HE fabrication mission in 2005.

Total site operations of the HE fabrication mission would result in HIs for the public (0.034) and the onsite worker (0.05) that are within acceptable health levels. The cancer risks for the public (5.15×10^{-6}) and the onsite worker (1.54×10^{-4}) slightly exceed the EPA default value of 1x10-6. Incremental emissions due to the HE fabrication mission cause only a minimal increase in HI for the public and onsite worker and no additional cancer risk for the public and the onsite worker.

Cancer risks for the public and for the onsite worker exceed the EPA default value as a result of the No Action emissions of chloroform, methylene chloride; 1,1,2-trichloroethane; and trichloroethylene.

Sharing of the HE Fabrication alternative mission with LLNL would be expected to reduce emissions of hazardous chemicals by up to 50 percent. Therefore, HI and cancer risk impacts may be reduced up to 50 percent as a result of HE fabrication mission sharing with LLNL. This would bring the cancer risk to an acceptable level of 1x10-6.

Nonnuclear Fabrication

Radiological Impacts. There are no radiological impacts associated with this alternative.

Hazardous Chemical Impacts. Hazardous chemical impacts for the public and for the onsite worker resulting from normal operation of the nonnuclear fabrication alternative at LANL are presented below. The nonnuclear fabrication alternative includes detonators and the option of adding reservoirs, plastics, or both to this mission. The HI and cancer risk would remain constant over 25 years of operation provided exposures remain the same. Analyses to support the values presented in this section are provided in appendix table E.3.4-17.

The incremental HI to the maximally exposed member of the public would be 2.61×10^{-5} and the incremental cancer risk would be zero as a result of operation of the nonnuclear fabrication mission in 2005. The incremental HI for the onsite worker would be 3.15×10^{-6}, and the incremental cancer risk would be zero as a result of operation of the nonnuclear fabrication mission in 2005.

Total site operations and the incremental effect of the nonnuclear fabrication mission would result in HIs for the public (0.03) and the onsite worker (0.047) that are within acceptable health levels. The cancer risks for the public (5.15×10^{-6}) and the onsite worker (1.54×10^{-4}) slightly exceed the EPA default value of 1x10-6.

Cancer risks for the public and for the onsite worker exceed the EPA default value due to the No Action emissions of chloroform methylene chloride; 1,1,2-trichloroethane; and trichloroethylene. Incremental emissions due to the nonnuclear fabrication mission cause only a minimal increase in HI for the public and onsite worker and no additional cancer risk for the public and the onsite worker.

The emissions of hazardous chemicals may not increase, and may slightly decrease if the options of not including reservoirs, plastics, or both in the nonnuclear fabrication alternative is implemented. Therefore, it is not expected that there would be any increase in HI or cancer risk for the public or for the onsite worker by not including reservoirs, plastics, or both in the nonnuclear fabrication alternative at LANL.

Sensitivity Analysis. Radiological impacts may be subject to certain degrees of variance resulting from either high or low case operations. For the high case scenario, impacts to both the public and worker would be similar to the three-shift base case operations. For the low-case scenario, impacts to the total workforce would be expected to fall within the increment (range) projected between that of No Action and the pit fabrication alternative (less than 55.6 person-rem/year increase to the total site workforce). Impacts for the public would be expected to fall within the increment (range) projected between that of No Action and the secondary and case fabrication alternative (less than 0.2 mrem/year to the maximally exposed individual, and less than 0.5 person-rem/year for the population).

Based on the radiological impacts associated with normal operation of this alternative, all resulting doses would be within radiological limits and are well below levels of natural background radiation. The associated risks of adverse health effects for the public and to workers would be small.

Operations under the low case scenario for pit, secondary and case, HE, and nonnuclear fabrication are not expected to increase the emissions of hazardous chemicals at LANL. Since the HIs are well within the acceptable health limits, there are no adverse HI impacts for the public and the onsite worker expected. The low case scenario probably would not contribute to the expected adverse effects of cancer risk for the public and onsite worker.

Operations under the high case scenario for pit and secondary and case fabrication may increase the emissions of hazardous chemicals at LANL. Since the HIs are well within the acceptable health limits, there are no expected adverse HI impacts for the public and the onsite worker. The high case scenario probably would also not increase cancer risk for the public and onsite worker above the EPA default value.

Operations under the high case scenario for HE fabrication may result in up to a two-fold increase in the emissions of hazardous chemicals at LANL. Since the HIs are well within the acceptable health limits, no adverse HI impacts for the public and the onsite worker are expected. The high case scenario probably would not increase the cancer risk for the public and onsite worker above the EPA default value.

Operations under the high case scenario for nonnuclear fabrication may result in up to a three-fold increase in the emissions of hazardous chemicals at LANL. Since the HIs are well within the acceptable health limits, no adverse HI impacts for the public and the onsite worker are expected. The high case scenario may, however, contribute to the adverse effects of cancer risk for the public and onsite worker unless mitigation steps are implemented.

Stewardship Alternatives

Proposed National Ignition Facility

Radiological Impacts. Radiological impacts for the public resulting from normal operation of the proposed NIF for the enhanced option scenario are presented in table 4.6.3.9-1. These impacts are representative of the aggregate total which is estimated to exist from all future baseline operational LANL contributions and from enhanced option operations of the proposed NIF at the site. Total impacts are provided to compare with applicable regulations governing total site operations. To place doses for the public from this alternative into perspective, comparisons are made to natural background radiation. As shown in table 4.6.3.9-1, the total dose to the maximally exposed member of the public from annual total site operations is within radiological limits and would be 6.5 mrem for this alternative. The annual population dose within 80 km (50 mi) in 2030 would be 2.8 person-rem. The impacts incurred from proposed NIF operations are small when compared to those existing for the normal baseline site operations (see No Action column in table 4.6.3.9-1).

Total site doses to onsite workers from normal operation for the proposed NIF are presented in table 4.6.3.9-2. The average annual dose to involved workers for this alternative would be 30 mrem. The dose to the entire facility workforce (involved workforce) would be 8.0 person-rem. The presented noninvolved worker impacts were not modeled due to the unavailability of certain site-specific

information. There may also be small risks to construction workers who are involved with tasks that are in close proximity to potentially contaminated areas.

Based on the radiological impacts associated with normal operation of this alternative, all resulting doses would be within radiological limits and are well below levels of natural background radiation. The associated risks of adverse health effects for the public and to workers would be small.

Hazardous Chemical Impacts. No hazardous chemical impacts are expected from operation of the NIF (see appendix I). Therefore, HIs and cancer risks for the public and onsite workers were not calculated nor assessed.

Proposed Atlas Facility

Radiological Impacts. There are no radiological impacts associated with this alternative. Total site doses and impacts characteristic of this alternative are equal to the No Action alternative.

Hazardous Chemical Impacts. Minimal hazardous chemical impacts are expected from operation of the Atlas Facility (see appendix K). Therefore, HIs and cancer risks for the public and onsite workers were not calculated nor assessed.

Combined Program Impacts

Radiological Impacts. Radiological impacts to the public and to workers from the simultaneous operation of all LANL site alternatives (both management and stewardship) would result in very small increases over the No Action or the largest individual alternative. All Program totals would be within radiological limits and are well below levels of natural background radiation. The associated risks of adverse health effects to the public and to workers would be small.

Combined Program impacts due to hazardous chemical emissions from operation of the No Action alternative and the incremental chemical emissions incurred by the management alternatives (pit fabrication, secondary and case fabrication, HE fabrication, and nonnuclear fabrication) would result in a cumulative HI for the public of 0.035 and a cumulative cancer risk of 5.15×10^{-6}. The cumulative HI for the onsite worker would be 0.051 and the cumulative cancer risk would be 1.54×10^{-4}.

The cumulative Program HIs (noncarcinogenic effects) for the public and the onsite worker are within acceptable health levels since the HIs do not exceed the value of 1. Concern for potential health effects is heightened when the HI exceeds 1. Cumulative cancer risks for the public and the onsite worker exceed the cancer risk default value of 1x10-6 under No Action when extremely conservative stack parameters are used. When average LANL stack flows are used, the cancer risk for the public and the onsite workers do not exceed this default value for any alternatives. The incremental chemical emissions due to operations associated with all of the management alternatives did not increase the cancer risks.

Potential Mitigation Measures.Radioactive airborne emissions to the general population and onsite exposures to workers could be reduced by implementing the latest technology for process and design improvements. For example, to reduce public exposure from emissions, improved building and work area control methods could be used to remove radioactivity from the releases to the environment. Similarly, the use of remote, automated and robotic production methods are examples of techniques that are being developed which would reduce worker exposure (see section 3.5).

Measures such as substituting less-toxic solvents or modifying processes are proposed to reduce or eliminate the emissions of all hazardous chemicals due to site operations, with particular attention to methylene chloride; 1,1,2-trichloroethane; and trichloroethylene.

Facility Accidents. The proposed actions have the potential for accidents that may impact the health and safety of workers and the public. The potential for and associated consequences of reasonably foreseeable accidents that have been evaluated are summarized in this section and described in more detail in appendix F. The methodology used in the assessment is described in section 4.1.9. A list of documents reviewed for applicable accident data is provided in appendix table F.1.1-1. The potential impacts from accidents, ranging from high-consequence/low-probability to low-consequence/high-probability events, have been evaluated in terms of potential cancer fatalities that may result for noninvolved workers and the public. The risk of cancer fatalities has also been evaluated to provide an overall measure of accident impacts and is calculated by multiplying the accident annual frequency (or probability) of occurrence by the consequences (number of cancer fatalities). A figure is also provided showing the risk of latent cancer fatalities in the population within 80 km (50 mi) that may result from accidents for the alternatives. Specifically, the curves in each figure show the probability (vertical axis) that the number of cancer fatalities in the offsite population within 80 km (50 mi) (horizontal axis) will be exceeded. The curves reflect the probability of the accident.

In addition to the potential impacts to noninvolved workers and the offsite population, there are potential impacts to involved workers who would be located in the facilities associated with the proposed action. Quantitative statements of these impacts cannot be made until design details are developed further, at which time the number and location of facility workers protective and mitigating features can be estimated to support accident impact analyses. However, depending on the type of accident, facility workers in close proximity to the point of the accident could receive high levels of exposure to radiation, with potentially fatal impacts.

No Action. Under the No Action alternative, limited pit fabrication, nonnuclear fabrication, and stewardship R&D would continue to be performed at LANL with no changes to facilities and operations. Under existing conditions, potential accidents and their consequences have been addressed in facility safety documentation according to requirements in DOE orders.

Management Alternatives. This section provides accident information on the four management alternatives under consideration at LANL: pit fabrication, secondary and case fabrication, HE fabrication, and nonnuclear fabrication.

Pit Fabrication . A set of potential accidents has been postulated for the pit fabrication and intrusive and nonintrusion modification pit reuse alternative for which there may be releases of radioactive materials or other hazardous effects that may impact onsite workers and the offsite population. The accident impacts of greatest interest are those associated with pit fabrication and/or intrusive modification. Any potential accident impacts associated with nonintrusive modification would be bounded by the intrusive modification activity impacts. The potential accidents analyzed are described in appendix F. The probability distribution showing the range of probable cancer fatalities that may result for the composite set of accidents identified in appendix F is shown in figure 4.6.3.9-1. For example, the probability of a pit fabrication accident causing more than 0.1 cancer fatalities is approximately 10^{-6} per year. The curve reflects the probability of the accidents occurring. The impacts for the composite set of accidents are shown in table 4.6.3.9-3. If an accident were to occur, there would be an estimated 1.2×10^{-4} cancer fatalities in the population within 80 km (50 mi) of the

site. A noninvolved worker located 1,000 m (3,281 ft) from the accident would have an increased likelihood of cancer fatality of 6.4×10^{-7} . A maximally exposed individual located at the site boundary would have an increased likelihood of cancer fatality of 4.3×10^{-7} . The risks for the composite set of accidents, reflecting both the probability of the accident occurring and the consequences, are also shown in table 4.6.3.9-3. For the same worker, maximally exposed individual, and population, the risks would be 3.3×10^{-8} , 2.2×10^{-8} , and 6.2×10^{-6} cancer fatalities per year, respectively. There is also a potential for chemical accident impacts as shown in table 4.6.3.9-4.

Secondary and Case Fabrication . A set of potential accidents has been postulated for the secondary and case fabrication alternative for which there may be releases of radioactive materials or other hazardous effects that may impact onsite workers and the offsite population. The potential accidents analyzed are described in appendix F. The probability distribution showing the range of probable cancer fatalities that may result for the composite set of accidents identified in appendix F is shown in figure 4.6.3.9-1. For example, the probability of a secondary and case fabrication accident causing more than one cancer fatality is approximately 10^{-8} per year. The curve reflects the probability of the accidents occurring. The impacts of the composite set of accidents are shown in table 4.6.3.9-3. If an accident were to occur, there would be an estimated 0.02 cancer fatalities in the population within 80 km (50 mi) of the site. A noninvolved worker located 862 m (2,828 ft) from the accident would have an increased likelihood of cancer fatality of 6.8×10^{-5} . For a maximally exposed individual located at the site boundary, there would be an increased likelihood of cancer fatality of 8.4×10^{-5} . The risks for the combined EBA and BEBA composite set of accidents, reflecting both the probability of the accident occurring and the consequences, are also shown in table 4.6.3.9-3. For the same worker, maximally exposed individual and population, the risks would be 4.1×10^{-9} , 5.1×10^{-9} , and 1.2×10^{-6} cancer fatalities per year, respectively. Table 4.6.3.9-3 also shows the impacts for EBAs only and BEBAs only. There is also a potential for chemical accidents and impacts as shown in table 4.6.3.9-5.

Table 4.6.3.9-3.-- Impacts of Accidents for Pit and Secondary and Case Fabrication and Intrusive and Nonintrusive Modification Pit Reuse at Los Alamos National Laboratory

	Pit Fabrication and Intrusive Modification Pit Reuse			**Secondary and Case Fabrication**		
Parameter	**EBA**	**BEBA**	**EBA and BEBA Combined**	**EBA**	**BEBA**	**EBA and BEBA Combined**
Composite Accident Frequency (Per Year)	0.0152	1.0×10^{-6}	0.0152	6.0×10^{-5}	5.0×10^{-7}	6.0×10^{-5}
Consequences						
Noninvolved Worker						
Cancer fatality[19]	6.4×10^{-7}	3.8×10^{-5}	6.4×10^{-7}	6.3×10^{-5}	6.2×10^{-4}	6.8×10^{-5}

Risk (cancer fatality per year)	$3.3x10^{-8}$	$3.8x10^{-4}$	$3.3x10^{-8}$	$3.8x10^{-9}$	$3.1x10^{-10}$	$4.1x10^{-9}$
Maximally Exposed Individual						
Cancer fatality[19]	$4.3x10^{-7}$	$2.6x10^{-5}$	$4.3x10^{-7}$	$7.9x10^{-5}$	$7.7x10^{-4}$	$8.4x10^{-5}$
Risk (cancer fatality per year)	$2.2x10^{-8}$	$2.6x10^{-11}$	$2.2x10^{-8}$	$4.7x10^{-9}$	$3.9x10^{-10}$	$5.1x10^{-9}$
Population Within 80 Kilometers [20]						
Cancer fatality[21]	$1.2x10^{-4}$	$7.1x10^{-3}$	$1.2x10^{4}$	0.018	0.18	0.02
Risk (cancer fatalities per year)	$6.2x10^{-6}$	$7.1x10^{-9}$	$6.2x10^{-6}$	$1.1x10^{-6}$	$8.9x10^{-8}$	$1.2x10^{-6}$

Table 4.6.3.9-4.-- Impacts of Chemical Accidents for Pit Fabrication at Los Alamos National Laboratory

					Concentration to:		Potential Im	
Accident Description	**Accident Frequency (Per Year)**	**IDLH**	**TLV-STEL**	**TLV-TWA**	**Noninvolved Worker (mg/m^3)**	**Individual at Site Boundary (mg/m^3)**	**IDLH Limits[22]**	**I**
Confined Release of Nitric Acid	10^{-6} to 10^{-4}				1.1	0.50	Irreversible health effects	Irr of mı
Concentration[22] (mg/m^3)		260	10	5				me an de
Distances[23] (m)		22	260	390				pu ed
Area (m^2)		64	$7.1x10^3$	$1.5x10^4$				br an
Population[24]		0	0	0				er

Unconfined Release of Nitric Acid	10^{-6}				26	12	Irreversible health effects	Irr of mı mı an de pu ed br an er
Concentration[22] (mg/m^3)		260	10	5				
Distances[23] (m)		230	1,900	2,900				
Area (m^2)		$6.5x10^3$	$2.9x10^5$	$6.8x10^5$				
Population[24]		0	19	330				

Table 4.6.3.9-5.-- Impacts of Chemical Accidents for Secondary and Case Fabrication at Los Alamos National Laboratory

					Concentrations to:		Potential I Excee	
Accident Description	**Accident Frequency (Per Year)**	**IDLH**	**TLV-STEL**	**TLV-TWA**	**Noninvolved Worker (mg/m^3)**	**Individual at Site Boundary (mg/m^3)**	**IDLH Limits[25]**	
Fire and release of lithium oxide	10^{-6} to 10^{-4}				>230	230	Irreversible health effects	
Concentration (mg/m^3)		55	-	0.025				
Distance[26] (m)		84 to 2,200		46 to $>9x10^4$				
Area (m^2)		$3.8x10^5$		$>5.7x10^8$				
Population[27]		520		>24,000				
Hydrogen fluoride release	10^{-6} to 10^{-4}				>32	32	Irreversible health effects	
Concentration (mg/m^3)		36	5	2.5				
Distance[26] (m)		800	2,800	4,400				
Area (m^2)		$5.7x10^4$	$5.9x10^5$	$1.4x10^6$				

Population [27]		0	820	1,500			
Hydrogen cyanide release	10^{-6} to 10^{-4}				>20	20	Irreversible health effects
Concentration (mg/m^3)		56	5	-			
Distance[26] (m)		460	2,000				
Area (m^2)		$2.0x10^4$	$3.3x10^5$				
Population		0	430				

High Explosives Fabrication. A set of potential accidents has been postulated for the HE fabrication alternative for which there may be hazardous effects that may impact onsite workers and the offsite population. The potential accidents analyzed are described in appendix F. The consequences of the accidents are shown in table 4.6.3.9-6.

In addition to the chemical accident impacts, there are the potential physical effects from a catastrophic explosion of the entire contents of a process related building, which would have a probability of occurrence less than the explosion considered above (i.e., less than $1.0x10^{-6}$ per year). The quantity of HE detonated could range up to 18 t (19.8 tons); the blast pressure could result in death (at up to 40 m [131 ft]), lung damage (at 80 m [262 ft]), thoracic injury (at 130 m [420 ft]), and eardrum rupture (at 160 m [525 ft]), depending on an individual's distance from the accident. Injuries could also be caused by glass breakage and building debris.

Nonnuclear Fabrication. The impacts of potential accidents associated with nonnuclear fabrication activities at LANL were previously addressed in Nonnuclear Consolidation Environmental Assessment (DOE/EA-0792, June 1993) where it was determined that the then current accident profile would not change as a result of the relocation of nonnuclear fabrication functions to LANL. The present proposed action to transfer the nonnuclear fabrication mission to LANL is not expected to change the accident profile that presently exists at the site.

Stewardship Alternatives. Accident information on the two proposed stewardship alternatives under consideration at LANL, the NIF and the Atlas Facility, is provided in this section.

Proposed National Ignition Facility . Studies of potential accidents associated with the proposed NIF have been performed. A bounding accident was postulated based on a preliminary hazard analysis. The bounding accident assumes a severe earthquake of 1 G horizontal ground acceleration occurring during a maximum-credible-yield fusion experiment. Beamlines streaking into the target chamber and building structures other than the target area building would fail during the postulated earthquake. The collapsed beamlines and building structures would provide a pathway for acute atmospheric releases of tritium in the tritium processing system, activated gases in the air, and activated material in the target chamber.

The frequency of this severe earthquake is estimated at $1x10^{-4}$ per year. The joint frequency of the

severe earthquake during the maximum-credible-yield fusion experiment would be less than $2x10^{-8}$ per year. The radiological impacts of the accident, presented in table 4.6.3.9-7, were estimated using the GENII computer code.

Proposed Atlas Facility . Studies of potential accidents associated with the proposed Atlas Facility have been performed. The results of the studies indicate that the bounding case accident for a site worker involves electrocution from a high energy power source or mechanical collapse of the overhead crane. Both scenarios have an equal likelihood of occurrence. The impact to a site worker in these scenarios could be death. However, the likelihood of occurrence is less than once in 100 years of operation. The most likely accident that could result in an impact to collocated workers involves exposure to emissions and effluents from a capacitor bank fire. In this scenario, a collocated worker would receive minimal exposure to smoke and sprinkler system water containing mineral oil from a Marx module. The impact to a collocated worker in this scenario would be temporary irritation and discomfort; however, the likelihood of occurrence is less than once in 10,000 years of operation. In the event of a fire, all site and collocated workers would be evacuated.

The most likely accident scenario that could result in an impact to the public involves exposure to emissions and effluents from a capacitor bank fire. In this scenario, a member of the public could receive minimal exposure to smoke. The impact to a member of the public in this scenario would be less than that experienced by a collocated worker. Exposure to the smoke could result in very mild and temporary irritation and discomfort. There are no probable accidents which would result in an adverse impact to the public.

Table 4.6.3.9-6.-- Accident Impacts for High Explosives Fabrication at Los Alamos National Laboratory

			Concentrations to:		Potential Impacts of Exceeding:
Accident Description	**Accident Frequency (per year)**	**TLV-TWA**	**Noninvolved Worker (mg/m^3)**	**Individual at Site Boundary (mg/m^3)**	**TLV-TWA Limits**
Fire and release of chemical TATB	0.01 to 10^{-4}		>50	50	Liver damage, cyanosis, sore throat, muscular pain, kidney damage, and anemia
Concentration[28] (mg/m^3)		1.5			
Distances[29] (m)		2,400			
Area (m^2)		$4.7x10^5$			

Population[30]		2			
Fire and release of chemical TNT	0.01 to 10^{-4}		>50	50	Liver damage, cyanosis, sore throat, muscular pain, kidney damage, and anemia
Concentration[28] (mg/m3)		0.5			
Distances[29] (m)		5,000			
Area (m^2)		$1.8x10^6$			
Population[30]		25			
Explosion and elevated release of TATB	10-4 to 10-6		6.4	6.7[31]	Liver damage, cyanosis, sore throat, muscular pain, kidney damage, and anemia
Concentration[28] (mg/m^3)		1.5			
Distances[29] (m)		180 to 3,500			
Area (m^2)		$1.1x10^6$			
Population[30]		8			
Explosion and elevated release of TNT	10^{-4} to 10^{-6}		2.4	2.5[31]	Liver damage, cyanosis, sore throat, muscular pain, kidney damage, and anemia
Concentration[28] (mg/m^3)		0.5			
Distances[29] (m)		170 to 3,700			
Area (m^2)		$1.2x10^6$			
Population[30]		9			

Table 4.6.3.9-7.-- Consequences and Risk of the Bounding Proposed National Ignition Facility Accident at Los Alamos National Laboratory

	Conceptual Design	Enhanced Baseline Option
Workers Onsite		
Dose (person-rem)	13	21
Fatal cancers	0	0
Risk (cancer fatalities per year)	1×10^{-10}	2×10^{-10}
Maximally Exposed Individual		
Dose (rem)	2×10^{-3}	3×10^{-3}
Fatal cancers	8×10^{-7}	1×10^{-6}
Risk (cancer fatalities per year)	2×10^{-14}	3×10^{-14}
Population Within 80 Kilometers		
Dose (person-rem)	290	490
Fatal cancers	0	0
Risk (cancer fatalities per year)	3×10^{-9}	5×10^{-9}

Source: Appendix I.

4.6.3.10 Waste Management

This section summarizes the impacts on waste management at LANL under No Action as well as for each of the proposed alternatives. There is no spent nuclear fuel or HLW associated with pit fabrication, secondary and case fabrication, HE fabrication, nonnuclear fabrication, the proposed Atlas Facility, or the proposed NIF; therefore, there is no further discussion of these wastes for LANL. Table 4.6.3.10-1 lists the projected waste generation rates and treatment, storage, and disposal capacities under No Action. Projections for No Action were derived from 1993 environmental data, with the appropriate adjustments made for those changing operational requirements where the volume of wastes generated is identifiable. The projection does not include wastes from future, as yet uncharacterized, environmental restoration activities.

Table 4.6.3.10-2 provides the total estimated operational waste volumes projected to be generated at LANL as a result of the various proposed alternatives. The net increase over No Action is provided below in parentheses. The waste volumes generated from the various alternatives and the resultant waste effluent used in the impact analysis can be found in section 3.3 for the stewardship alternatives and section 3.4 for the management alternatives. The waste volumes for the management alternatives are based on surge operations (three shifts). Facilities that would support the Stockpile Stewardship and Management Program at LANL would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the Atomic Energy Act, RCRA, and other applicable statutes as outlined in appendix section H.1.2.

No Action. Under No Action, TRU, low-level, mixed, hazardous, and nonhazardous wastes would continue to be generated at LANL from the missions outlined in section 3.2.6. The decrease in solid LLW is due to the phase out of the PHERMEX Facility as the new DARHT Facility with contained firing becomes operational. LANL would continue to treat, store, and dispose of its legacy and newly generated wastes in current and planned facilities.

Liquid TRU waste would continue to be generated by the Plutonium Facility (TA-55). The residual TRU waste sludge that remains after treatment would continue to be loaded into 208-L (55-gal) steel drums, solidified, and transported to Area G for storage. Solid TRU waste would be characterized, certified to meet the criteria for acceptance at WIPP, and placed in storage at Area G while awaiting shipment to WIPP or an alternate facility. Plans are to develop a new facility for characterizing and processing solid TRU waste. This new facility is projected to be operational in 2006.

Liquid LLW would be neutralized and solidified in two onsite treatment facilities. Solid LLW would be compacted, packaged, and stored for disposal either in an onsite, expanded Area G LLW burial site or through other disposal options. Liquid mixed waste would undergo neutralization/pH adjustment, oxidation/reduction, precipitation, chelation/flocculation, and filtration. Both liquid and solid mixed waste would be treated and disposed of according to the LANL Site Treatment Plan, which was developed pursuant to the *Federal Facility Compliance Act* of 1992. The resulting waste would then be stored in a RCRA-permitted facility in DOT-approved containers until it is shipped to an offsite DOE disposal facility. Some of this waste would be placed in interim storage until new technologies for treatment and disposal are identified and evaluated. Liquid sanitary wastes would be treated by a consolidation and collection system and discharged to NPDES-permitted sanitary tile fields. Solid nonhazardous waste would be disposed of in a regional commercial disposal facility.

Table 4.6.3.10-1.-- Projected Waste Management Under No Action at Los Alamos National Laboratory

Category	Annual Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disp Cap (n
Transuranic							
Liquid	0.1	Pretreatment at TA-50: neutralization, clariflocculation, filtration, precipitate, and cement mixing	132,659	NA	NA	NA	NA

Solid	54	Volume reduction	51,989	Storage pads at TA-54, modified LLW burial pits and shafts	24,355	None: Federal repository in the future	Non(
Mixed Transuranic							
Liquid	None	Included in TRU	Included in TRU	Included in TRU	Included in TRU	Included in TRU	Inclu in TI
Solid	255	Included in TRU	Included in TRU	Included in TRU	Included in TRU	Included in TRU	Inclu in TI
Low-Level							
Liquid	21,400	Chemical treatment and ion-exchange, solidification, and volume reduction (vial crusher)	45 m^3 /hour	Chemical and Ion-Exchange Plant at TA-50 and the Chemical Plant at TA-21	663	Treated effluent is discharged to the environment. Residual sludge is solidified and disposed of at TA-54, Area G, as solid LLW.	Non(
Solid	2,500	Compaction	76	TA-54 in Area G	Variable	Currently, solid LLW goes to TA-54, Area G, for burial. Continued construction of Area G is under evaluation in the site-wide EIS.	24 tc ha
Mixed Low-Level							

Liquid	0	Neutralization, precipitation, oxidation, thermal treatment, solidification, volume reduction, and liquid scintillation cocktail vials	Capabilities under development per site treatment plan for mixed wastes	RCRA-permitted buildings (not built yet) and interim status container storage areas	583	Capabilities under development per site treatment plan for mixed wastes	Non(
Solid	45	None	Capabilities under development per site treatment plan	TA-54, Area L, or Area G	1,864	Capabilities under development per site treatment plan for mixed wastes	Non(
Hazardous							
Liquid	273	Thermal treatment, treatment tanks, neutralization, precipitation, and evaporation	Varies depending on the waste stream	Thermal treatment TAs -14, -15, -16, -36, and -39 and storage and treatment at TA-54, Area L	502	Offsite	NA
Solid	669	Thermal treatment and flashpad	Varies depending on the waste stream	See above	See above	See above	See abov
Nonhazardous (Sanitary)							
Liquid	692,827	Filtration, settling, and stripping	1,060,063	NA	NA	Permitted discharge sanitary tile fields	2,27 L/da

Solid	5,453	None	None	NA	NA	Offsite county landfill and onsite landfill Area J	NA
Nonhazardous (Other)							
Liquid	See sanitary	See sanitary	See sanitary	See sanitary	See sanitary	See sanitary	See sanit
Solid	See sanitary	See sanitary	See sanitary	See sanitary	See sanitary	See sanitary	See sanit

Table 4.6.3.10-2.-- Estimated Annual Generated Waste Volumes for Stockpile Stewardship and Management Alternatives at Los Alamos National Laboratory

Category	No Action[32] (m^3)	Pit Fabrication[33] (m^3)	Secondary and Case Fabrication[34] (m^3)	High Explosives Fabrication[35] (m^3)	Nonnuclear Fabrication (Full Scope)[36] (^{3})	Atlas Facility[37] (m^3)	Nationa Ignitior Facility (m^3)
Transuranic							
Liquid	0.1	5 (+5)	0.1	0.1	0.1	0.1	0.1
			(+0)	(+0)	(+0)	(+0)	(+0)
Solid	54	97	54	54	54	54	54
		(+43)	(+0)	(+0)	(+0)	(+0)	(+0)
Mixed Transuranic							
Liquid	0	0	0	0	0	0	0
		(+0)	(+0)	(+0)	(+0)	(+0)	(+0)
Solid	255	257	255	255	255	255	255
		(+2)	(0)	(0)	(0)	(0)	(0)
Low-Level							
Liquid	21,400	21,400	21,600	21,400	21,400)	21,400	21,400
		(+15)	(+192)	(0)	(0	(0)	(+0.6)
Solid	2,500	2,880	3,190	2,500	2,500	2,500	2,500
		(+386)	(+690)	(minimal)	(0)	(0)	(+3)
Mixed Low-Level							
Liquid	0	0	30	0	0	0	2

		(+0)	(+30)	(0)	(0)	(0)	(+2)
Solid	45	45	153	45	45	45	45
		(0)	(+108)	(0)	(0)	(0)	(+0.3)
Hazardous							
Liquid	273	275	333	277	284	273	275
		(+2)	(+60)	(+4)	(+11)	(+<1)	(+2)
Solid	669	669	885	682	669	670	677
		(+0)	(+216)	(+13)	(+0.1)	(+<1)	(+8)
Nonhazardous (Sanitary)							
Liquid	693,000	705,000	713,000	699,000	694,000	694,000	711,000
		(+12,300)	(+20,200)	(+5,900)	(+568)	(+710)	(+17,90(
Solid	5,450	6,000	6,610	5,450	5,460	5,460	11,500
		(+552)	(+1,160)	(Included in liquid)	(+10)	(+7)	(+6,000)
Nonhazardous (Other)[32]							
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	6,930[39]	25[40]	Included in sanitary	Included in sanitary
				(+6,930)			
Solid	Included in sanitary	Included in sanitary	3,000[40]	28[40]	(+25) 3[40]	Included in sanitary	Included in sanitary
			(+3,000)	(+28)	(+3)		

Management Alternatives

Pit Fabrication. Over the 3-year construction period, it is estimated that approximately 27 t (30 tons) of TRU waste and 54 t (60 tons) of LLW would be generated. These numbers assume that about 20 glove boxes from the 300 Area and 10 glove boxes from the 400 Area would be removed. The glove boxes should meet the definition of LLW; whereas, approximately two-thirds of the associated piping and ventilation ductwork would be considered TRU waste. Assuming a density of 1,500 kg/m^3 , this is a volume of 6 m^3 /yr (8 yd^3 /yr) of TRU waste and 12 m^3 /yr (16 yd^3 /yr) of LLW. The TRU waste would be packaged to meet the WIPP Waste Acceptance Criteria and stored until it is shipped to WIPP for disposal. This would require two additional truck shipments over the entire construction period. The LLW would be packaged to meet the Area G waste disposal criteria. This would require approximately 0.003 ha (0.007 acres) of LLW disposal area for the entire construction project. Liquid and solid hazardous waste generated during construction would be packaged and shipped offsite to RCRA-permitted treatment and disposal facilities.

Treatment and processing of liquid and solid TRU, and solid mixed TRU wastes to meet the WIPP Waste Acceptance Criteria would result in 60 m^3 (78 yd^3) of TRU waste and 2 m^3 (3 yd^3) of solid mixed TRU waste to be packaged in accordance with DOE and NRC requirements for transport to WIPP for disposal. Seven additional truck shipments per year would be required to transport this waste to WIPP. There is adequate excess capacity at LANL liquid radwaste treatment facilities to handle the 15 m^3 (3,940 gal) of liquid LLW. Following treatment and processing, 393 m^3 (514 yd^3) of solid LLW would require disposal at the Area G LLW disposal site. Assuming a land usage factor of 12,500 m^3 /ha (6,630 yd^3 /acres), approximately 0.03 ha/yr (0.08 acres/yr) of LLW disposal area at LANL would be required.

The LANL Site Treatment Plan for mixed waste was developed pursuant to the Federal Facility Compliance Act. The mixed waste streams identified at LANL have been combined into 30 treatability groups, each with a preferred treatment option. The type of mixed wastes generated by pit fabrication would fit into 1 of the established 30 treatability groups and would not create new treatability groups or new preferred treatment options. Minimal impacts would result from the 2 m^3 (555 gal) of liquid hazardous waste that would be staged in the onsite hazardous waste accumulation area and shipped to offsite commercial RCRA-permitted treatment, storage, and disposal facilities. Minimal impacts would result from the 12,300 m^3 (3.25 million gal) of liquid sanitary waste that would be routed to the TA-46 sanitary wastewater treatment facilities. Minimal impacts would result from the 552 m^3 (722 yd^3) of solid nonhazardous waste that would be disposed of in offsite industrial and sanitary landfills.

Secondary and Case Fabrication. The Secondary and Case Fabrication Facility would not generate any TRU waste. The 192 m^3 (50,700 gal) of liquid LLW would have little impact on LANL radwaste treatment facilities as there is adequate capacity to handle the increase. After treatment and volume reduction, 349 m^3 (456 yd^3) of solid LLW would require disposal in the Area G LLW disposal site. Assuming a land usage factor of 12,500 m^3 /ha (6,630 yd^3 /acres), approximately 0.03 ha/yr (0.07 acres/yr) of LLW disposal area would be required.

The type of mixed wastes generated by secondary and case fabrication would fit into 1 of the established 30 treatability groups and would not require the creation of new treatability groups or new preferred treatment options. The 30 m^3 (7,930 gal) of liquid mixed wastes and 108 m^3 (141 yd^3) of solid mixed wastes generated annually may impact the available storage capacity of the main areas for future mixed waste storage in RCRA-permitted hazardous waste management units. Minimal impacts would result from the 60 m^3 (15,900 gal) of liquid hazardous waste and 216 m^3 (283 yd^3) of solid hazardous waste that would be staged in the onsite hazardous waste accumulation area and shipped to offsite commercial RCRA-permitted treatment, storage, and disposal facilities. Minimal impacts would result from the 20,200 m^3 (5.35 million gal) of liquid sanitary waste that would be routed to septic tanks or sanitary wastewater treatment facilities. After volume reduction, minimal impacts would result from the 639 m^3 (836 yd^3) of solid nonhazardous waste that would be disposed of in offsite industrial and sanitary landfills.

High Explosives Fabrication. The HE Fabrication Facility would not generate any TRU waste, or mixed LLW. Minimal quantities of solid LLW would be generated annually either from handling depleted uranium parts during subassembly operations or from processing of materials returned from

the stockpile with slight contamination. The operational life of the Area G LLW disposal site would not be impacted. Minimal impacts would result from the 4 m^3 (925 gal) of liquid hazardous waste and 13 m^3 (16 yd^3) of solid hazardous waste that would be staged in the onsite hazardous waste accumulation area and shipped to offsite commercial RCRA-permitted treatment, storage, and disposal facilities. Minimal impacts would result from the 5,900 m^3 (1.56 million gal) of liquid sanitary waste that would be routed to septic tanks or sanitary wastewater treatment facilities. Minimal impacts would result from the 17 m^3 (22 yd^3) of solid nonhazardous waste that would be disposed of in offsite industrial and sanitary landfills.

Nonnuclear Fabrication. The Nonnuclear Fabrication Facility would not generate any TRU, low-level, or mixed low-level wastes. Minimal impacts would result from the 11 m^3 (3,000 gal) of liquid hazardous waste and 0.1 m^3 (0.13 yd^3) of solid hazardous waste that would be staged in the onsite hazardous waste accumulation area and shipped to offsite commercial RCRA-permitted treatment, storage, and disposal facilities. Minimal impacts would result from the 568 m^3 (150,000 gal) of liquid sanitary waste that would be discharged to the sanitary wastewater system and the 11 m^3 (15 yd^3) of solid nonhazardous waste that would be disposed of in offsite industrial and sanitary landfills.

Sensitivity Analysis . The waste volumes generated from the pit, secondary and case, HE, and nonnuclear fabrication alternatives required to support a larger stockpile level (high case) operating on a single-shift basis are bounded by the base case under surge operations. There would be no additional waste management impacts associated with the alternatives that would support a high case stockpile operating at a single shift. The volumes generated from the proposed alternatives required to support a low case stockpile would be reduced by a factor of at least 3.

Stewardship Alternatives

Proposed National Ignition Facility. The proposed NIF would not generate any TRU waste. The 0.6 m^3 (159 gal) of liquid LLW could be treated with existing onsite capabilities with no impact. The 3 m*3* (4 yd^3) of solid LLW would have a minimal impact on the operational life of the Area G LLW disposal site. Assuming a land usage factor of 12,500 m^3 /ha (6,630 yd^3 /acres), 0.0002 ha/yr (0.0006 acres/yr) of LLW disposal area would be required.

The LANL Site Treatment Plan for mixed waste was developed pursuant to the Federal Facility Compliance Act. The mixed waste streams identified at LANL have been combined into 30 treatability groups, each with a preferred treatment option. The type of mixed wastes generated by the proposed NIF would fit into 1 of the established 30 treatability groups and would not require the creation of new treatability groups or new preferred treatment options. The 2 m^3 (528 gal) of liquid mixed LLW and the 0.3 m^3 (0.4 yd^3) of solid mixed LLW generated would not impact the available storage capacity of the main areas for future mixed waste storage in RCRA-permitted hazardous waste management units. Minimal impacts would result from the 2 m^3 (608 gal) of liquid hazardous waste and 8 m^3 (10 yd^3) of solid hazardous waste that would be staged in the onsite hazardous waste accumulation area and shipped to offsite commercial RCRA-permitted treatment, storage, and disposal facilities. The 17,900 m^3 (4.72 million gal) of liquid sanitary waste would not be expected to impact the existing sanitary wastewater treatment system. Minor impacts would result from the 6,050 m^3 (7,910 yd^3) of solid nonhazardous waste that would be disposed of in offsite industrial and sanitary landfills.

Proposed Atlas Facility. For purposes of this analysis it is assumed that a small amount (<1 m^3 annually) of liquid or solid hazardous waste would be generated by occasional experiments involving lead or other simulant materials. This waste would be staged in the onsite hazardous waste accumulation area and shipped to offsite commercial RCRA-permitted treatment, storage, and disposal facilities. Minimal impacts would result from the generation of 710 m^3 (188,000 gal) of liquid sanitary waste as there is adequate capacity within the existing sanitary wastewater treatment system to handle the increase. Minimal impacts would result from the 9 m^3 (12 yd^3) of solid nonhazardous waste that would be disposed of at the Los Alamos County landfill.

Combined Program Impacts. If all the proposed stockpile stewardship and management alternatives listed in table 4.6.3.10-2 were located at LANL, the impacts from TRU and mixed TRU wastes would be identical to those discussed for the pit fabrication alternative. Following treatment and volume reduction, approximately 745 m^3 (925 yd^3) of solid LLW would require disposal at the Area G LLW disposal site. An estimated 0.06 ha (0.15 acres) of LLW disposal area would be required. The impacts from mixed low-level and hazardous wastes are identical to those discussed for the secondary and case fabrication alternative. The 57,600 m^3 (15.2 million gal) of liquid sanitary wastes would not be expected to impact the sanitary wastewater treatment system since adequate capacity exists to handle this increase. After volume reduction, approximately 7,270 m^3 (9,510 yd^3) of solid sanitary waste would require disposal. This increase could require the construction of a new sanitary landfill sooner than currently planned.

Potential Mitigation Measures . Waste quantities or waste forms could undergo additional reductions by utilizing emerging technologies, thereby further reducing or mitigating impacts. Pollution prevention and waste minimization would be considered in determining the final actions of the Stockpile Stewardship and Management Program at LANL.

4.6.3.11 Environmental Justice

As discussed in section 4.14, any impacts to surrounding communities would most likely result from toxic or hazardous air pollutants and radiological emissions. Section 4.6.3.9, which describes public and occupational health impacts from normal operation, shows that potential chemical air emissions and releases are not within the generally acceptable threshold of regulatory concern. This information is based on the conservative programmatic assumptions and modeling detailed in appendix E. However, the cumulative effect of continuous (or intermittent over time) very low exposures could have some impact on human health or the environment. Any adverse human health or environmental impacts that may occur would affect people living within communities located near LANL. The analysis of the demographic data presented in appendix D for the communities surrounding LANL indicates that if there were any adverse health impacts to these communities, they would not appear to disproportionately affect minority or low-income populations.

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1 Generator power sources already in use by LANL.

Note: NA - not applicable.
Source: LANL 1995b:1; LANL 1995b:3; LANL 1995b:4; LANL 1995c; LANL 1995d; LANL 1995e; LANL 1995g; LANL 1996e:1; appendix I; appendix K.

2 State standard or guideline. The conversion from ppm to g/m^3 for ambient air quality standards is calculated with the corrections for temperature (530°R) and pressure (elevation) (7,400 ft mean sea level).

3 Federal standard.

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

5 No standard.
Source: 40 CFR 50; DOE 1995hh; LANL 1995b:1; LANL 1995c; LANL 1995d; LANL 1995e; LANL 1995g; NM EIB 1995a; NM EIB 1996a; appendix I.

6 Total water requirements for construction at LANL are based on a 4-year period for Atlas Facility, a 2-year period for nonnuclear fabrication and HE fabrication, a 4-year period for secondary and case fabrication, and a 5-year period for the proposed NIF.

7 No construction water would be used or construction wastewater generated. Total site water use and wastewater discharged would be the same as No Action operation.

8 NPDES permit is required for stormwater discharges.
NA - not applicable; MLY - million liters per year.
Source: LANL 1995b:1; LANL 1995c; LANL 1995d; LANL 1995e; LANL 1995g; LANL 1996e:1; appendix I; appendix K.

9 Assumes operations are located at TA-3.

10 Conservative assumption poses existence of maximally exposed individual at multiple locations simultaneously.

11 Includes impacts from No Action.

12 The applicable radiological limits for an individual member of the public from total site operations are 10 mrem/yr from the air pathways, 4 mrem/yr from the drinking water pathway, 100 mrem/yr from all pathways combined (DOE Order 5400.5).

13 Natural background radiation levels to average individual is 342 mrem/yr; to the population within 80 km (50 mi) in 2030 is 95,200 person-rem. Impacts from the Phased Containment Option (preferred alternative) representing the DARHT Facility are included within the No Action values presented in the table. However, PHERMEX Facility operations at LANL will be phased out and are therefore not included. Annual incremental doses of 1.7×10^{-5} mrem to the maximally exposed individual and 8.6×10^{-5} person-rem to the population are incurred from the pit fabrication alternative.
Source: DOE 1995hh; LANL 1995e; LANL 1995g; LANL 1995s; appendix I; appendix K.

14 Assumes operations are located at TA-3.

15 The involved worker is a worker associated with operation of the pit fabrication, secondary and case fabrication, NIF, and other facilities. The dose presented for the involved workforce is only that

incremental dose received from the pit fabrication, secondary and case fabrication, NIF, and Atlas Facility. The total dose received by the involved workforce would be higher than that received by the noninvolved workforce from these operations. The estimated number of involved workers is 267 at the proposed NIF, 146 for pit fabrication, and 151 for secondary and case fabrication.

16 The radiological limit for an individual worker is 5,000 mrem/yr (10 CFR 835).

17 The noninvolved worker is an onsite worker not associated with operation of the proposed stockpile stewardship and management facilities. The maximum estimated number of noninvolved workers is 5,770 for each of the stockpile stewardship and management alternatives.

18 The total site workforce is the sum of the number of involved and noninvolved worker impacts. The estimated numbers of badged workers in the total site workforce for each of the radiologically concerned alternatives are 5,916 for pit fabrication, 5,921 for secondary and case fabrication, 6,037 for the proposed NIF, and 5,770 for No Action.
Impacts to workers presented in this table include the addition of the Phased Containment Option (preferred alternative) representing the DARHT Facility and the phasing out of the PHERMEX Facility at LANL; NA - not applicable.
Source: DOE 1993n:7; DOE 1995hh; LANL 1995b:6; LANL 1995e; LANL 1995g; appendix I; appendix K.

19 Probability (increased likelihood) of cancer fatality to a hypothetical member of the public located at the site boundary or to a noninvolved worker as a result of exposure to the indicated dose if the accident occurred.

20 For the offsite population of 287,977 for pit fabrication and 281,812 for secondary fabrication, the average probability of cancer fatality/risk of cancer fatality (per year) for the combined EBA and BEBA is 4.2×10^{-10} /2.2×10^{-11} and 7.1×10^{-8} /4.3×10^{-12} respectively, for the listed alternative(s), pit fabrication, and secondary and case fabrication.

21 Number of cancer fatalities in the population out to 80 km (50 mi) as a result of exposure to the indicated dose if the accident occurs.
All values are mean values; BEBA - beyond evaluation basis accidents; EBA - evaluation basis accidents.
Results shown are derived from accident analyses in appendix F.

22 NIOSH 1990a.

23 From facility (downwind); exceedance begins at facility, 0 meters.

24 Offsite individuals exposed to concentration exceeding limit.
IDLH - immediately dangerous to life and health; TLV - threshold-limit value; STEL - short-term exposure limit; TWA - time-weighted average.
Source: Model result (see appendix F).

25 NIOSH 1990a.

26 From facility (downwind); exceedance begins at facility, 0 meters, unless indicated otherwise.

27 Offsite individuals exposed to concentration exceeding limit.
IDLH - immediately dangerous to life and health; TLV - threshold-limit-value; STEL - short-term exposure limit; TWA - time-weighted average.
Source: Derived from accident analysis (see appendix F).

28 NIOSH 1990a.

29 From facility (downwind); exceedance begins at facility, 0 meters, unless indicated otherwise.

30 Offsite individual exposed to concentration exceeding limit.

31 Individual at 510 m (1,673 ft) from boundary (individual at boundary is exposed to concentrations of approximately two times lower)
TLV - threshold limit value; TWA - time weighted average; TATB - triaminotrinitrobenzene; TNT - trinitrotoluene.
Source: Results derived from accident analysis (see appendix F).

32 No Action volumes are from table 4.6.3.10-1.

33 Pit fabrication volumes are from table 3.4.3.2-3.

34 Secondary fabrication volumes are from table 3.4.4.3-3 and are based on surge operations (three shifts).

35 HE fabrication volumes are from table 3.4.5.3-4 and are based on surge operations (three shifts).

36 Nonnuclear fabrication volumes are from table 3.4.2.3-3 and are based on surge operations (three shifts).

37 Atlas Facility volumes are from table 3.3.2.3-3.

38 NIF volumes are from table 3.3.2.2-3 and are based on conceptual designs.

39 Treated process water.

40 Recyclable wastes.
Waste generation volumes were rounded to three significant figures. Waste effluent volumes are shown in section 3.3 and 3.4 tables for each alternative.

4.7 Lawrence Livermore National Laboratory

LLNL was established in 1952 and currently occupies approximately 332 ha (821 acres) next to Livermore, CA (Livermore Site), and 2,800 ha (7,000 acres) at Site 300, approximately 29 km (18 mi) southeast of Livermore in support of missions discussed in section 3.2.7. The locations of the sites are illustrated in figure 4.7-1. Figure 4.7-2 shows the DOE property boundaries for the Livermore Site.

4.7.1 Description of Alternatives

No Action. LLNL would continue to perform the missions described in section 3.2.7.

Stockpile Management Alternatives. The secondary and case fabrication mission, the HE fabrication mission, and a portion of the nonnuclear fabrication mission could be located at LLNL. The HE fabrication mission could also be shared with LANL.

Stockpile Stewardship Alternatives. The Contained Firing Facility (CFF) would be located at Site 300 and the proposed NIF could be located at the Livermore Site.

4.7.2 Affected Environment

The following sections describe the affected environment at the LLNL main site (Livermore Site) and Site 300 for land resources, air quality, water resources, geology and soils, biotic resources, cultural and paleontological resources, and socioeconomics. In addition, the infrastructure, radiation and hazardous chemical environment, waste management conditions, and current intersite transport issues are described.

4.7.2.1 Land Resources

LLNL consists of two sites: the main facility (approximately 332 ha [821 acres]) at Livermore, and Site 300 (approximately 2,800 ha [7,000 acres]) in the Tracy Hills, approximately 29 km (18 mi) east of the Livermore Site. Both sites are owned by the Federal Government and administered, managed, and controlled by DOE.

Livermore Site . Generalized land uses within the Livermore Site and in the immediate vicinity are shown in figure 4.7.2.1-1. The site itself is categorized into a variety of land uses, with the vast majority dedicated to R&D. The R&D designation includes office facilities, light and heavy laboratories, and light industrial facilities in direct support of programmatic endeavors. A significant portion of the site is classified as undeveloped and industrial uses occupy a substantial amount of land. There are no prime farmlands on the Livermore Site.

The Livermore Site is bordered on the east by Greenville Road. Land use on the east is primarily agricultural. The South Bay Aqueduct, a branch of the California Aqueduct, crosses Greenville Road just south of the Livermore Site. Patterson Pass Road borders the Livermore Site on the north. Land to the immediate north of Patterson Road is light industrial and vacant land. The Patterson Reservoir and filtration plant, part of the South Bay Aqueduct system, are located northeast of the site. The Livermore Site is bordered on the west by South Vasco Road. Land use to the west is primarily urban residential, with some vacant land.

The Livermore Site is bordered on the south by East Avenue. Sandia National Laboratories, Livermore, is located immediately adjacent and south of East Avenue. A small light-industrial park is located on the southwest corner of East Avenue and South Vasco Road. The remainder of lands south of the Livermore Site and Sandia National Laboratories, Livermore, are primarily agricultural, comprised of vineyards and rangeland primarily used for grazing. There are also some rural residences in these areas. The closest residences to the boundaries of the Livermore Site are 0.4 km (0.25 mi) to the east, 0.56 km (0.35 mi) to the west, 2.0 km (1.2 mi) to the north, and 0.8 km (0.50 mi) to the south.

Site 300 . Generalized land uses within Site 300 and in the immediate vicinity are shown in figure 4.7.2.1-2. The site itself consists of a large percentage of undeveloped territory and land dedicated to both R&D and industrial functions. There are no prime farmlands on Site 300. No significant land use changes are projected for Site 300 at present (LLNL 1995k:16-19).

The majority of the land surrounding Site 300 is agricultural and is primarily used for grazing sheep and cattle. There are two, privately operated, research and testing facilities located near Site 300. Physics International is located adjacent to the east boundary, and Stanford Research Institute International is approximately 0.97 km (0.60 mi) south of the site. Both of these facilities conduct HE testing similar to that conducted at Site 300 (LL DOE 1992c:4-6). Corral Hollow Road borders Site 300 on the south. Adjacent to the western portion of Site 300, across Corral Hollow Road, is the Carnegie State Vehicular Recreation Area. This area covers approximately 6,483 ha (16,020 acres) and is operated by the California Department of Parks and Recreation, Off-Highway Motor Vehicle Recreation Division, for the exclusive use of off-road vehicles. Several rural residences are located along Corral Hollow Road, west of Site 300 and the Carnegie State Vehicular Recreation Area. The closest residences to the boundaries of Site 300 are 0.48 km (0.3 mi) to the east, 0.16 km (0.1 mi) to the west, 3.5 km (2.2 mi) to the north, and 0.72 km (0.45 mi) to the south. The nearest urban area is the city of Tracy, approximately 13 km (8.1 mi) to the northeast.

4.7.2.2 Site Infrastructure

Section 3.2.7 describes the current missions at LLNL. To support these missions an infrastructure exists as shown in table 4.7.2.2-1.

Table 4.7.2.2-1.-- Baseline Characteristics for Lawrence Livermore National Laboratory

Characteristics	**Current Value**	
Land	**Main Site**	**Site 300**
Area (ha)	332	2,800
Roads (km)	24	40
Railroads (km)	0	0
Electrical		
Energy consumption (MWh/yr)	327,716	15,661

Peak Load (MWe)	57.2	2.6
Fuel		
Natural Gas (m3/yr)	14,160,000	NA
Liquid (L/yr)	31,688	43,527
Coal (t/yr)	0	0

NA - not applicable.
Source: LLNL 1995i:1.

4.7.2.3 Air Quality

This section describes existing air quality, including a review of the meteorology and climatology in the vicinity of the Livermore Site and Site 300. More detailed discussions of the air quality methodologies, input data, and atmospheric dispersion characteristics are presented in appendix section B.3.7.

Meteorology and Climatology. The climate at the Livermore Site, Site 300, and the surrounding region is classic Mediterranean with hot dry summers and cold wet winters. The average annual temperature at the Livermore Site is 12.5 °C (54.5 °F); the normal seasonal temperature range is defined by winter nighttime lows in the vicinity of 0 °C (32 °F) and summer daytime highs around 38 °C (100.4 °F). The highest and lowest annual precipitation on record are 78.2 cm (30.8 in) and 13.8 cm (5.4 in), respectively. Prevailing winds at the Livermore Site are from the west and southwest. The climate at Site 300, while similar to the Livermore Site, is modified by higher elevation and more pronounced relief. The temperature range is somewhat more extreme than the Livermore Site. Topography significantly influences surface wind patterns at Site 300 with prevailing winds from the west-southwest (LLNL 1993b:1-2,1-3).

Ambient Air Quality. The Livermore Site is located within the San Francisco Bay Area Air Quality Management District. With respect to attainment of the NAAQS (40 CFR 50), this area has been designated as follows: A part of Alameda County, which is in the San Francisco Bay Area Air Quality Management District, is designated as nonattainment for carbon monoxide (with a classification of moderate 12.7 ppm) and ozone (with a classification of moderate) (40 CFR 81.305). Site 300 is located within the San Joaquin Valley Unified Air Pollution Control District. The area is classified as a nonattainment area for ozone (with a classification of serious) and PM10 (with a classification of serious) (40 CFR 81.305). Applicable NAAQS and California State ambient air quality standards are presented in appendix table **B.3.1-1 .**

The primary emission sources of criteria air pollutants at the Livermore Site and Site 300 are numerous boilers, solvent cleaning operations, emergency generators, and various experimental, testing, and process sources. Emission estimates for these sources are presented in appendix table **B.3.7-1 .**

Several PSD Class I areas have been designated in the vicinity of the Livermore Site, including Point Reyes National Wilderness Area, approximately 89 km (55 mi) to the northwest; and Desolation National Wilderness Area, Mokelumne National Wilderness Area, Emigrant National Wilderness Area, Hoover National Wilderness Area, and Yosemite National Park, approximately 160 to 190 km (100 to 120 mi), respectively, to the east and northeast. Since the promulgation of the PSD

regulations (40 CFR 52.21) in 1977, no PSD permits have been required for any emission sources at the Livermore Site.

Table 4.7.2.3-1.--Comparison of Baseline Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines at the Livermore Site and Site 300, 1993 and 1994

Pollutant	Averaging Time	Most Stringent Regulation or Guideline (g/m3)	Livermore Site Baseline Concentration (g/m3)	Site 300 Baseline Concentration (g/m3)
Criteria Pollutant				
Carbon monoxide	8-hour	10,000[1]	55.79	4.96
	1-hour	23,000[2]	187.80	39.68
Lead	Calendar quarter	1.5[1]	<0.01	[3]
	30-day	1.5[2]	<0.01	[3]
Nitrogen dioxide	Annual	100[1]	5.46	0.28
	1-hour	470[2]	1,082.64	183.54
Ozone	1-hour	180[2]	[3]	[3]
Particulate matter	Annual	30[2]	0.78	0.03
	24-hour	50[2]	15.32	0.91
Sulfur dioxide	Annual	80[1]	0.07	<0.01
	24-hour	105[2]	1.42	0.09
	3-hour	1,300[1]	9.35	0.71
	1-hour	655[2]	14.35	2.12
Mandated by California				
Beryllium	30-day	0.01[4]	0.000089	0.000049
Hydrogen sulfide	1-hour	42[2]	[3]	[3]
Sulfates	24-hour	25[2]	[3]	[3]
Vinyl chloride	24-hour	26[2]	[3]	[3]

Hazardous and Other Toxic Compounds

Acetone	8-hour	5	8.11	0.12
Benzene	8-hour	5	0.99	<0.01
2-Butoxyethanol	8-hour	5	1.52	3
Carbon tetrachloride	8-hour	5	2.03	3
Chlorofluorocarbons	8-hour	5	86.28	0.44
Chloroform	8-hour	5	1.87	<0.01
Ethanol	8-hour	5	3.19	<0.01
Formaldehyde	8-hour	5	0.53	0.01
Gasoline	8-hour	5	3	0.98
Glycol ethers (other)	8-hour	5	0.03	0.14
Hexane	8-hour	5	0.59	3
Hydrogen chloride	8-hour	5	0.64	0.16
Isopropyl alcohol	8-hour	5	7.23	<0.01
Methanol	8-hour	5	9.41	3
Methyl ethyl ketone	8-hour	5	3.35	<0.01
Methylene chloride	8-hour	5	1.33	<0.01
Naphthalene	8-hour	5	0.73	3
Styrene	8-hour	5	12.59	3
Tetrahydrofuran	8-hour	5	0.61	3
Toluene	8-hour	5	3.81	0.05
1,1,1-Trichloroethane	8-hour	5	9.73	3
Trichloroethylene	8-hour	5	1.74	0.01
Xylene	8-hour	5	2.20	0.01

The State of California employs a health-risk based program for toxic air pollutants. As required by the *California Air Toxic "Hot Spots" Information and Assessment Act* of 1987 (AB2588), the Bay Area Air Quality Management District and the San Joaquin Valley Unified Air Pollution Control District requested that the Livermore Site and Site 300 assess the impact of toxic air emissions on the surrounding area. The risks at the Livermore Site were found to be below the threshold values that are used to determine need for further evaluation. The Site 300 toxic air pollutant inventory has been completed and will be submitted to the San Joaquin Valley Unified Air Pollution Control District for review to determine if a risk assessment is required (LLNL 1993b:2-24).

The "Hot Spots" program, however, is not applicable to the other stockpile stewardship and management candidate sites. To compare with the other stockpile stewardship and management candidate sites, the predicted maximum 8-hour concentrations for toxic air pollutants are provided. Table 4.7.2.3-1 presents the baseline ambient air concentrations for criteria pollutants and other hazardous/toxic air pollutants of concern at the Livermore Site and Site 300. As shown in the table, criteria pollutant baseline concentrations are in compliance with applicable guidelines and regulations, with the exception of 1-hour nitrogen dioxide at the Livermore Site.

4.7.2.4 Water Resources

This section describes the surface and groundwater resources at LLNL. This site includes the facilities in the Livermore Valley and at Site 300, referred to here as Livermore Site and Site 300, respectively.

Surface Water

Livermore Site. The main surface water features at the Livermore Site are the Arroyo Las Positas and Arroyo Seco. Arroyo Las Positas drains in the hills directly east and northeast of the Livermore Site and usually flows only after storms (figure 4.7.2.4-1). This channel enters the Livermore Site from the east, is diverted along a storm ditch around the northern edge of the site, and exits the site at the northwest corner. Arroyo Seco flows through the very southwest corner of the Livermore Site. Arroyo Las Positas flows into Arroyo Seco west of the site. Both stream channels are dry for most of the year.

Nearly all surface water runoff at the Livermore Site is discharged into Arroyo Las Positas; only surface water runoff along the southern boundary and some storm drains in the southwest corner of the Livermore Site drain into Arroyo Seco (LL DOE 1992c:4-147). The locations of hydrological features are shown in figure 4.7.2.4-1.

Two areas on the Livermore Site are within the 100-year floodplains of the Arroyo Las Positas and Arroyo Seco. However no existing onsite structures are within the 100-year floodplain. The channels routing Arroyo Las Positas and Arroyo Seco through the Livermore Site would be able to contain a 100-year flood. The 500-year flood levels have not been delineated.

The total annual water use at the Livermore Site is currently 968 MLY (256 MGY). LLNL receives water from two suppliers. During the summer months, June through August, deliveries are taken primarily from the Alameda County Flood Control and Water Quality Conservation District Zone 7. This water is a mixture of groundwater and water from the South Bay Aqueduct of the State Water Project. For the remainder of the year, LLNL's water usually is supplied from the Hetch-Hetchy Aqueduct.

Approximately 400 MLY (106 MGY) of wastewater from the Livermore Site is discharged to the city of Livermore sewer system and processed at the Livermore Water Reclamation Plant (LLNL 1994a:5-1). This wastewater includes sanitary and industrial discharges from the Livermore Site and Sandia National Laboratories. The discharges are permitted by the city of Livermore and monitored for pH, selected metals, and radioactivity (LLNL 1994a:5-2). LLNL also monitors the waters of the Livermore Site, Site 300, and surrounding areas, as well as stormwater runoff.

Site 300. There are no perennial streams at or near Site 300. The canyons that dissect the hills and ridges at Site 300 drain into intermittent streams. The majority of these onsite streams drain to the south into Corral Hollow Creek, also intermittent, which flows east along the southern boundary of Site 300 in the San Joaquin Valley. In addition to these streams, 24 springs and 2 vernal pools exist onsite. Some surface water discharge occurs from cooling towers and other process runoff areas.

A tapline from the Hetch-Hetchy Aqueduct has been constructed with a capacity of 1.9 MLD (0.502 MGD) or 693 MLY (183 MGY). However, Site 300 has not been connected to the service as of yet. Site 300 is planning to use a new water supply from the San Francisco Water Department via the Aqueduct and the Coast Ridge Tunnel (LLNL 1991b:6).

At Site 300, stormwater, cooling tower water, and groundwater that has been treated to remove contaminants are discharged to onsite or adjacent drainages in accordance with NPDES permit conditions. Approximately 4.8 MLY (1.3 MGY) of wastewater is discharged to the wastewater sewage pond. The maximum capacity of the sanitary wastewater sewage pond in the General Services Area is 12 MLY (3.2 MGY).

Based on the flow and stream channel widths, 100-year flood events would be contained within the channels except for portions of Greenville Road (LL DOE 1992c:6-9). There is no information available for delineating the 500-year floodplain at Site 300. The lined drainage retention basin at Site 300 mitigates effects from significant flooding.

Surface Water Quality

Livermore Site. Offsite surface water bodies in the vicinity of the Livermore Site are routinely monitored for radioactive parameters. In addition, stormwater runoff at the Livermore Site is routinely monitored for radioactive and nonradioactive parameters. Approximately 25 percent of the stormwater runoff generated within the site drains into the lined Central Drainage Retention Basin, and the remainder drains either directly, or via a system of storm sewers and ditches, into Arroyo Seco or Arroyo Las Positas. Table 4.7.2.4-1 summarizes the monitoring results at the Livermore Site for 1993. Maximum concentrations of gross beta were above their comparison criteria at least once in 1993. There was one instance of noncompliance with wastewater permit limits in 1994: a discharge of methylene chloride. This event was reported to the city of Livermore Water Reclamation Plant. Table 4.7.2.4-2 summarizes the surface water monitoring results from the Arroyo Seco at the Livermore Site.

Table 4.7.2.4-1.-- Stormwater Quality Monitoring at the Livermore Site, 1993

Parameter	Unit of Measure	Water Quality Criteria[6]	Water Body Concentration Range	
			ASW[7]	WPDC[8]
Radiological				
Alpha (gross)	pCi/L	15[9]	0.27-10.8	1.4-10.5

Beta (gross)	pCi/L	20[10]	3.0-20.8	4.1-18.4
Tritium	pCi/L	80,000[11]	239-531	75.7-194
Nonradiological				
Arsenic	mg/L	0.05[9]	<0.002-0.0029	<0.002-0.0054
Bis (2-Ethylhexyl) phthalate	mg/L	NA	<10-12	<10-13
ChromPium	mg/L	0.1[9]	<0.005-0.0059	<0.005
Chloride	mg/L	250[12]	<1-19	1-24
pH	pH unit	6.5 - 8.5[12]	6.7[13]	6.9[13]
Sulfate	mg/L	250[11]	<2-42	5.2-220
Total alkalinity (as CaCO3)	mg/L	NA	11-46	18-72
Total dissolved solids	mg/L	500[12]	110[12]	95[13]
Zinc	mg/L	5[12]	0.33[12]	0.24[13]

Site 300. At Site 300, surface water samples analyzed in 1994 for gross beta and tritium showed concentrations below maximum contaminant levels for drinking water, except for gross alpha radiation for one sampling event. No concentrations were above comparison criteria in 1993.

Surface Water Rights and Permits. LLNL holds several permits pertaining to local, state, and Federal regulations: NPDES permits; Waste Discharge Requirements permits for any discharge of wastes that could adversely affect the beneficial uses of water; a city of Livermore Water Reclamation Plant permit for wastewater discharges to the city sanitary sewer system; and California Department of Fish and Game permits for streambed alteration for any work that may disturb or impact rivers, streams, or lakes.

Groundwater

Livermore Site. Groundwater at the Livermore Site occurs in an upper unconfined zone overlying a series of semiconfined aquifers. The two geologic units containing the most important aquifers are the surface valley-fill deposits (shallow alluvial aquifer) and the Livermore Formation (semi-confined aquifer).

Table 4.7.2.4-2.-- Maximum Concentrations of Constituents in Surface Water of the Arroyo Seco at the Livermore Site, 1993

Parameter	Unit of Measure ASS2[15]	Water Quality Criteria[14]	Water Body Concentration Range
Radiological			
Alpha (gross)	pCi/L	15[16]	1.08-5.9
Beta (gross)	pCi/L	50[17]	3.5-9.7
Tritium	pCi/L	20,000[16]	74-374
Nonradiological			
Bis (2-Ethylhexyl)-phthalate	mg/L	NA	34
Chloride	mg/L	250[18]	<1-6.2
Fluoride	mg/L	4[16]	<1-0.065
Nitrate/nitrite as NO3	mg/L	10[16]	1.4-2.4
Sulfate	mg/L	250[16]	<2-25

The Livermore Site is located within the Spring subbasin of the Livermore Valley groundwater basin. The aquifers are locally recharged by the stream runoff from precipitation and controlled releases from the South Bay Aqueduct, direct rainfall, irrigation, and treated groundwater infiltration. In addition, stream channels and ditches, and gravel pits west of the city of Livermore also recharge the shallow alluvial aquifer. Groundwater is also naturally discharged from the basin at Arroyo de la Laguna located 18 km (11 mi) southwest of the Livermore Site (LL DOE 1992c:4-151). Depth to the shallow alluvial aquifer beneath the Livermore Site ranges from approximately 9 to 34 m (30 to 110 ft). Groundwater generally flows westward throughout much of the site and southwest in the southeast area of the Livermore Site.

Site 300. At Site 300, there are two regional aquifers or major waterbearing zones: an aquifer in the sandstones and conglomerates of the Neroly Formation and a deep confined aquifer also located in the Neroly Formation. The deep confined aquifer (122 to 152 m deep [400 to 499 ft]), beneath the southern part of the site within the Neroly Formation, provides the water supply for Site 300. In addition, there are a number of local perched groundwater zones. These are not significant aquifers, because water quality is poor and yields are low. Groundwater flow in the deep confined aquifer is controlled by the sandstone beds (LLNL 1995n:E.2.4-27). North of the Patterson Anticline, which is roughly in the center of Site 300, (figure 4.7.2.4-2) water moves to the northeast, and south of the Anticline it moves to the southeast (LLNL 1994a:8-5). Runoff that has concentrated in Elk Ravine and Corral Hollow Creek recharges local bedrock aquifers. No aquifers in the Site 300 area are considered sole source aquifers under the Safe Drinking Water Act (SDWA).

Groundwater Quality

Livermore Site . Groundwater in the vicinity of the Livermore Site is generally suitable as a domestic, municipal, agricultural, and industrial supply, with the exception of groundwater less than 91 m (300 ft) deep (LL DOE 1992c:4-164). A network of groundwater monitoring and extraction wells at the Livermore Site is routinely monitored for radioactive and nonradioactive parameters. Maximum concentrations of gross alpha, nitrate/nitrite, trichloroethylene, and tritium were above their water quality criteria/standard in 1993. The maximum concentrations for tritium are found in one localized well within the Livermore Site boundary (LLNL 1994a:7-14), and pose no threat to water supplies.

VOCs have been detected in the onsite groundwater and in the area around the Livermore Site. All site practices known to contribute VOCs to groundwater have been discontinued. Investigations, however, have determined that VOC-contaminated water is present under 85 percent of the Livermore Site. The contaminant plumes have migrated off site in two areas. One plume containing mainly tetrachloro-ethylene extends from the southwest corner of the Livermore Site about 762 m (2,500 ft) west of Vasco Road under private property. It is migrating to the northwest at a rate of about 21 m (68.9 ft) per year. Three municipal supply wells are situated within about 4.4 km (2.4 mi) of this plume. The other plume, which contains primarily trichloroethylene, extends about 244 m (800 ft) south onto DOE property administered by Sandia National Laboratories, Livermore. LLNL is working with EPA and the State of California to identify appropriate remedial measures.

Approximately 150 million L (34.3 million gal) of groundwater in the southwest corner of the facility have been treated to remove VOCs. The treated water is discharged either to a recharge basin south of the site or to stream channels in accordance with NPDES permit limitations.

Site 300. At Site 300, groundwater is sampled quarterly from inactive and active water supply wells and monitoring wells. Samples are analyzed for radioactive and nonradioactive parameters (table 4.7.2.4-3). Maximum concentrations of arsenic, gross alpha, nitrate/nitrite, trichloroethylene, tritium, and uranium were above their water quality criteria/standard at least once in 1993 (LLNL 1994a: 7-17-7-18). Currently, LLNL is investigating and identifying characteristics of the groundwater contamination at Site 300. Several plumes of VOCs and tritium have been identified in shallow and deeper bedrock aquifers in this and adjacent offsite areas (LLNL 1994a:7-16-7-17). LLNL is working with the EPA and California to remediate these plumes.

Groundwater Availability and Use

Livermore Site . The Livermore Site relies on imported surface water for its municipal, commercial, residential, and agricultural uses, supplemented only by a relatively small amount of treated groundwater used for irrigation and cooling tower makeup. The water from the supply wells is blended with imported surface water before distribution to the public.

Site 300 . At Site 300, approximately 90 MLY (23.8 MGY) of water are extracted from two groundwater supply wells located in the southeast portion of the site. Other water supply wells located near Site 300 are used for recreation, stock watering, and potable purposes.

Groundwater Rights and Permits. Groundwater rights in the State of California are traditionally associated with Correlative Rights, which are derived from the concept that water users will share the resource during droughts, based on the relative areal extent of the land owned by the competing landowners. If no competition for water exists, then landowners can withdraw groundwater to the extent that they exercise their rights reasonably in relation to the similar rights of others. Because the

majority of the water supply at Site 300 is from onsite wells, the present water restriction is the capacity and recharge of the wells.

Table 4.7.2.4-3.-- Groundwater Quality Monitoring at Site 300, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[19]	Well K1-08[20]	Well NC7-25[21]	W-817-01[22]
Radiological					
Alpha (gross)	pCi/L	15[23]	-0.11-1.62	23-29.7	NA
Beta (gross)	pCi/L	50[24]	2.1-3.2	18.6-26.5	NA
Radium-226	pCi/L	3[23]	-0.17-0.460	0.73-1.2	NA
Tritium	pCi/L	20,000[23]	<43.2-24.3	233,000-298,000	<45.9-22.4
Uranium-233,234	pCi/L	20[25]	0.86-1.84	10-12.7	NA
Uranium-235	pCi/L	24[25]	0.013-0.241	0.30-0.86	NA
Uranium-238	pCi/L	24[25]	0.54-0.81	7.6-12.2	NA
Nonradiological					
Arsenic	mg/L	0.05[23]	0.012-0.017	0.0048-0.0068	0.036-0.058
Chromium	mg/L	0.1[23]	<0.01	NA	<0.005-0.0037
1,2-Dichloroethene	mg/L	0.005[23]	NA	<0.0005-<0.001	<0.0005
Lead	mg/L	0.015[23]	<0.002	<0.0002	<0.002-<0.1
Nitrate/nitrite	mg/L	10[23]	5.2-8.1	NA	71-81
RDX	mg/L	NA	NA	NA	<30-117
Tetrachloroethylene	mg/L	0.005[23]	NA	NA	<0.0005
1,1,1-Trichloroethane	mg/L	0.2[23]	NA	<0.0005	NA
Trichloroethylene	mg/L	0.005[23]	NA	0.0005	<0.0005

Trichlorotrifluoro-ethane	NA	NA	NA	0.001	NA

4.7.2.5 Geology and Soils

Geology

Livermore Site. The Livermore Site is located within the California Coast Ranges, an area of north-northwest trending ranges and valleys. Livermore Valley, an exception to this trend, forms an east-west structural basin defined by branches of the San Andreas fault system. The Livermore Site occupies a smooth land surface that slopes gently to the northwest.

The Livermore Site is underlain by late Tertiary and Quaternary rocks that lie on basement rocks of the Franciscan assemblage, which consist of severely deformed sandstone, shale, and chert. In the Livermore area, this unit is mainly sandstone. The Livermore Valley topographic and structural basin was formed in Pliocene time by movements along faults to the east and west. The basin is filled with 1,219 m (4,000 ft) of Pliocene to Holocene alluvial gravels, sands, and lacustrine clays of the Livermore Formation. Late Quaternary alluvial deposits immediately underlie the Livermore Site.

The historically active, northwest-trending Calaveras fault zone, the easternmost branch of the San Andreas fault system in the San Francisco Bay area, traverses the western margin of Livermore Valley. The Concord-Green Valley fault and parallel trending Greenville fault zone define the eastern boundary of Livermore Valley. In addition, two other capable faults, the Las Positas and Verona faults, as well as several inactive faults, cut the southern part of Livermore Valley. The Livermore Site lies in an area of historically inactive faulting, 1.6 km (1.0 mi) north of the Las Positas fault zone and less than 3.2 km (2.0 mi) west of the Greenville fault zone (figure 4.7.2.5-1).

The Livermore Site lies within seismic Zone 4 (figure A.1-1). The Calaveras fault has had several earthquakes of Richter magnitude 5.0 or greater in the last 150 years. A maximum probable earthquake greater than magnitude 7.0 is possible. In 1980, an earthquake sequence on the Greenville fault produced two earthquakes of magnitude 5.5 and 5.6. There are also surface indications of other recent seismic events, and the maximum credible earthquake estimated for this fault zone is magnitude 6.6 0.2. Although the Las Positas fault zone has no recorded historical movement, a portion of the Las Positas fault from northeast of Arroyo Mocho to a point 229 m (751 ft) east of Greenville Road lies in a special studies zone under the Alquist-Priolo Act. This act requires that active fault location studies be performed before building permits can be issued for most classes of construction (LLNL 1984a:49). The maximum credible earthquake for this fault zone is magnitude 6.0 0.5 (modified Mercalli intensity VI or greater) (LLNL 1984a:52). The potentials for surface faulting, damage from liquefaction, and slope instability at the Livermore Site are all low (LL DOE 1992c:4-84,4-86). The potential for volcanic activity is low as well (DOE 1995cc:4-66).

Site 300. Site 300 is located at the eastern margin of the California Coast Ranges, 16 km (10 mi) east of Livermore Valley. The site lies in an area of northwest-trending steep hills and ridges separated by ravines and is underlain by Eocene to Pliocene sedimentary rocks that rest on a basement of the Cretaceous Great Valley Sequence. Late Miocene to Pliocene interbedded sandstones, siltstones, and claystones are exposed in much of the site. Cretaceous, Eocene, and Early Miocene rocks are also present along the northern and southern borders of the site. These rocks are locally overlain by Quaternary alluvial and terrace deposits and Holocene colluvium, alluvium, and valley fill deposits.

Site 300 lies within seismic Zone 4 (appendix figure A.1-1). Two major faults cut Site 300. The Carnegie and Corral Hollow faults cross the southern boundary of the site; Holocene movement has occurred along these faults (LLNL 1991d:1). The combined Corral Hollow-Carnegie fault zone may be capable of generating an earthquake of Richter magnitude 6.5 to 7.1. The inactive northwest-trending Elk Ravine fault cuts across the northeast section of the site. Site 300 facilities are not within a special studies zone. The principal seismic hazard would be the ground shaking associated with movement along either the Corral Hollow-Carnegie fault or Greenville fault, 8 km (5 mi) to the west of Site 300 (LLNL 1983a:49-52). Surface faulting at Site 300 in areas adjacent to the active Carnegie fault is possible, while the potential for liquefaction at Site 300 is low. The potential for seismically induced landslides at Site 300 still exists (LL DOE 1992c:4-87,4-89).

Soils

Livermore Site. The Livermore Site is located on soils originally classified as the Rincon-San Ysidro association. These soils are nearly level, loamy textured, shallow to very deep soils on older fans and floodplains. The hazard of erosion is slight to moderate. Several of these soils, including the Rincon, San Ysidro, and Zamora Series soils, have moderate to high shrink-swell potential (LL USDA 1966a:17). Recently, the entire area under the Livermore Site has been redesignated as urban and built-up land. There are no prime or unique farmland soils located at the Livermore Site.

Site 300. Site 300 soils in Alameda County belong to the Altamont-Diablo association. Soils in San Joaquin County have different designations than Alameda County soils, but the properties of these soils are identical. The water erosion hazard of these soils is slight to severe; the wind erosion hazard is slight. Many soils have a high shrink-swell potential. There is no prime or unique farmland on Site 300.

4.7.2.6 Biotic Resources

The following section describes biotic resources at the Livermore Site and Site 300 including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. A list of the threatened and endangered species that may be found on or in the vicinity of the Livermore Site and Site 300 is presented in appendix C.

Terrestrial Resources. The Livermore Site and Site 300 are located in the California Chaparral Province. The U.S. Forest Service has classified the general vegetation type of the region as annual grasslands (USDA 1977a).

Livermore Site. The Livermore Site includes developed areas surrounded by security zones of mostly grassland. Developed land area includes approximately 78 percent of the site. The undeveloped land in the security zones is grassland dominated by nonnative grasses such as ripgut brome (*Bromus diandrus*) and slender oat (*Avena barbata*). Arroyo Seco, a stream bed which runs across the southwestern corner of the site, is steep-sided and forms a relatively undisturbed habitat. Both native trees (such as red willow [*Salix spp.*] and California walnut [*Juglans hindsii*]) and introduced species (such as black locust [*Robinia pseudo-acacia*] and almond [*Prunus amygdalus*]) are present (LL DOE 1992c:4-91).

Five species of amphibians, 2 species of reptiles, 31 species of birds, and 10 species of mammals have been reported at the Livermore Site (LL DOE 1992d:F-33,F-36,F-39). Wildlife at the site

includes species that are found in the grassland habitat of the security zones and those that live in the developed areas or along the arroyos. Species found in the security zones include the western fence lizard (*Sceloporus occidentalis*), western meadowlark (*Sturnella neglecta*), black-tailed jackrabbit (*Lepus californicus*), and California ground squirrel (*Spermophilus beecheyi*). Nesting birds within the laboratory complex include the American crow (*Corvus brachyrhynchos*), American robin (*Turdus migratorius*), Anna's hummingbird (*Calypte anna*), white-throated swift (*Aeronautes saxatalis*), California quail (*Callipepla californica*), and house sparrow (*Passer domesticus*). Bird species observed along Arroyo Seco include the mourning dove (*Zenaida macroura*), acorn woodpecker (*Melanerpes formicivorus*), sharp-shinned hawk (*Accipiter striatus*), and turkey vulture (*Cathartes aura*) (LL DOE 1992c:4-95). Game animals include the California quail and desert cottontail (*Sylvilagus auduboni*). Raptors present on site include the red-tailed hawk (*Buteo jamaicensis*), Cooper's hawk (*Accipiter cooperii*), and golden eagle (*Aquila chrysaetos*), while carnivores present include the coyote (*Canus latrans*) and red fox *(Vulpes vulpes)* . Migrating birds present on site, as well as their nests and eggs, are protected by the Migratory Bird Treaty Act. Eagles are similarly protected by the Bald and Golden Eagle Protection Act.

Site 300. Five plant communities are found on Site 300 (figure 4.7.2.6-1). In addition, approximately 5 percent of the site has been disturbed. Introduced grassland is the largest community, covering 81 percent of the site. Native grassland, which covers 10 percent of the site, is the second most abundant community type. Coastal sage scrub and oak woodland plant communities occupy about 2 percent of the Site 300 area. Northern riparian woodland is considered rare on Site 300. Grazing has not been permitted on the site since 1953; thus, the area has more native grasses and herbs than neighboring property. Controlled burning of about 810 ha (2,000 acres) each year is conducted as a means of wildfire control and to aid in maintaining native grass communities. A total of 342 species of plants has been recorded on Site 300 (LL DOE 1992c:4-92; LL DOE 1992d:F-4).

Studies of Site 300 have identified 21 species of amphibians and reptiles, 79 species of birds, and 27 species of mammals (appendix J). Because of the abundance of grassland communities, species favoring this habitat type are most abundant on the site. Common animals found at Site 300 include the gopher snake (*Pituophis melanoleucus*), western meadowlark, savannah sparrow (*Passerculus sandwichensis*), California ground squirrel, and deer mouse (*Peromyscus maniculatus*). In addition, springs and the surrounding vegetation provide important habitat for a number of song birds and game animals (LL DOE 1992c:4-96,4-97). Game animals at Site 300 include the mule deer (*Odocoileus hemionus*), desert cottontail, and California quail. Hunting is not permitted onsite (LLNL 1992a:3). Additional important species found at Site 300 include raptors, such as the great-horned owl (*Bubo virginianus*) and northern harrier (*Circus cyaneus*), and carnivores, such as the coyote and bobcat (*Lynx rufus*). As is the case for the Livermore Site, migratory birds and eagles are protected by Federal legislation.

Wetlands

Livermore Site. Wetlands at the Livermore Site are limited to several small areas along Arroyo Las Positas, located at and downstream from culverts that channel runoff from surrounding areas. Two areas, totaling 0.12 ha (0.3 acres), are dominated by saltgrass (*Distichlis spicata*). A species of sedge (*Carex spp.*) is also common. One saltgrass wetland has both standing and flowing water and areas of very wet soil. The other saltgrass wetland is drier, with sandy soil. A third, smaller wetland (0.04 ha [0.1 acres]) is located in a culvert. Cattail (*Typha spp.*) is the dominant plant in this wetland with other species such as sedge and saltgrass also commonly observed. Both standing and flowing water have been observed in this area, and the soil is sandy (LL DOE 1992d:G-16).

Site 300. Wetlands at Site 300 were delineated according to methods contained in the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (January 10, 1989). Site 300 contains 2.7 ha (6.7 acres) of wetlands. The wetland areas are small and scattered on the site in approximately 16 locations. Many of the wetlands are associated with natural springs, although one is associated with a vernal pool, and several have been artificially created from Site 300 runoff. Many of the wetlands associated with springs are at the bottom of deep canyons. Typical wetland vegetation associated with these springs include cattail, rush (*Juncus spp.*), willow, and cottonwood (*Populus spp.*) (LL DOE 1992c:4-112; LL DOE 1992d:G-19,G-46-G-48).

Aquatic Resources

Livermore Site. Potential aquatic habitat on the Livermore Site consists of an intermittent drainage system, seeps, springs, ditches, and a groundwater retention basin. The intermittent drainage system comprises westward-flowing arroyos that contain water during the winter months. Arroyos on the site include Arroyo Las Positas, located along the northern edge of the Livermore Site, and Arroyo Seco, which crosses the southwest corner of the site. Because of their temporary nature, the arroyos do not support fish. The seeps, springs, and ditches also do not support fish; however, the groundwater retention basin contains a population of mosquito fish *(Gambusia affinis)* (LLNL 1995i:3).

Site 300. Potential aquatic habitat on Site 300 consists of vernal pools, ponds, springs, and drainages. There is one perennial stream on the site. A sewage lagoon is located on the property, but it does not support any fish populations (LL DOE 1992c:4-95). Ponds located in the southeast-central portion of the site, and springs and drainages located throughout the site, do not support fish populations (LLNL 1992a:1).

Threatened and Endangered Species

Livermore Site. Forty-six Federal- and state-listed threatened, endangered, and other special status species may be found on and in the vicinity of the Livermore Site (appendix table C-5). Eleven of these species have been observed on the Livermore Site, including the Federal-listed bald eagle *(Haliaeetus leucocephalus)*. The other observed species include state special concern species. Although suitable habitat for several listed species exists onsite, potential occurrence of most of the species in appendix table C-5 is minimal due to the lack of suitable habitat and negative survey results. Site surveillance would be required to verify the occurrence of any listed species. No critical habitat for threatened and endangered species, as defined in the Endangered Species Act (50 CFR 17.11; 50 CFR 17.12), exists on the Livermore Site.

Site 300. Forty-eight Federal- and state-listed threatened, endangered, and other special status species may be found on and in the vicinity of Site 300 (appendix table C-5). Twenty-four of these species have been observed on Site 300. These species include the Federal-listed American peregrine falcon *(Falco peregrinus anatum)* and large-flowered fiddleneck (*Amsinckia grandiflora*), and Federal-proposed endangered Alameda whipsnake *(Masticophis lateralis euryxanthus)* and California red-legged frog (*Rana aurora draytoni*). The other observed species include the state-listed Swainson's hawk and state special concern species. Potential occurrence of most of the other species listed in table C-5 is minimal due to lack of suitable habitat and negative survey results. Site surveillance would be required to verify their occurrence. No critical habitat for threatened and endangered species, as defined in the Endangered Species Act (50 CFR 17.11; 50 CFR 17.12), exists on Site 300.

4.7.2.7 Cultural and Paleontological Resources

Prehistoric Resources. The Livermore Site covers 332 ha (820 acres), 259 ha (640 acres) of which have been developed. Four cultural resources surveys have been conducted for undeveloped areas of the facility. No prehistoric resources were identified, and records searches indicated that no prehistoric resources had been previously recorded on or near the Livermore Site. Prehistoric sites identified in the vicinity of the Livermore Site and Site 300 include villages, campsites, rockshelters, and limited activity locations, including lithic scatters, hearths, and concentrations of fire-affected rocks. A cultural resources management plan is being developed to address issues of resource identification and maintenance.

A 1981 survey of Site 300 identified a quarry site, two prehistoric rockshelters, and one prehistoric rockshelter/historic graffiti site (LL DOE 1981a:2F.58). These sites were recorded but have not been evaluated to determine their eligibility for the NRHP.

Historic Resources. No historic sites have been recorded for the Livermore Site; however, buildings and facilities associated with the World War II-era Livermore Naval Air Station and themes in nuclear weapons development and other research projects may still be present. Because the Livermore Site was established in 1952, existing structures are not associated with the Manhattan Project or initial nuclear production. A formal NRHP evaluation of the buildings and facilities is currently being initiated.

The 1981 survey for parts of Site 300 resulted in 21 recorded historic sites, including historic graffiti, trash scatters, cabins, a foundation, a mine tunnel, a power/telegraph pole, and a townsite. The townsite, Carnegie, is a state-registered landmark. Most of the sites are associated with an industrial mining and manufacturing complex built in Corral Hollow Canyon between 1891 and 1918. Additional archival research is being conducted to clarify the characteristics of the Carnegie townsite. Site 300 was established in 1953; existing structures are not associated with the Manhattan Project or initial nuclear production.

Native American Resources. Native American groups known to have used Alameda and San Joaquin counties include the Costanoans (or Ohlone), Northern Yokuts, and Eastern Miwok. These groups were hunters and gatherers who relied on a variety of resources including deer, elk, antelope, fish, birds, nuts, and fruits. Individual tribes usually had a permanent village and occupied smaller campsites on a seasonal basis. The Northern Valley Yokuts and Eastern Miwok were decimated after European contact due to disease and acculturation, and no longer exist as a group. It is estimated that there are approximately 130 people of Costanoan (Ohlone) descent still living in the San Francisco Bay region.

Sacred and important Native American resources that might be found in the vicinity of the Livermore Site and Site 300 include burials, cremations, vision quest sites, and traditional use areas. Initial consultation with identified local Native American groups to determine important resources has begun.

Paleontological Resources. Most of the surficial and near-surface sediments of the Livermore Site are alluvial deposits of the Livermore Formation. They range in age from latest Pleistocene (15,000 to 20,000 years) to 100,000 years or greater and are not known to be fossiliferous. The only vertebrate fossil deposits in the vicinity of the Livermore Site are in the Quaternary deposits of the surrounding

low hills of the east Livermore Valley, but the fossils are few in number and quite scattered. They have been tentatively identified as Rancholabrean and Blancan in age (Pleistocene) and consist of bone fragments of mammoth and giant ground sloth.

Geological formations with paleontological materials at Site 300 are the Franciscan Complex and the Cierbo and Neroly Formations. The Franciscan Complex gravels are known to contain Icthyosaurus fossils; however, no known localities have been recorded within Site 300. The Cierbo Formation outcrops extensively in the northwest quarter of Site 300 and contains Miocene oyster shells. Because these paleontological materials are relatively common, marine invertebrate assemblages are considered to have relatively low research potential.

More than 75 percent of Site 300 is Neroly Formation. Miocene (Caledonian age) mammal fossil deposits have been found within the Neroly Formation in the vicinity of Site 300 and Corral Hollow. Plant leaf and stem fossils have been recovered from the lower Neroly Formation. An assortment of vertebrate taxa are also represented, including camelids, mastodon, early horses, beavers, squirrels, and shrews. Fossil finds are generally widely scattered and consist of no more than several bone fragments. Numerous fossil bones and bone fragments from the Neroly Formation have been found on the south side of Corral Hollow Creek, adjacent to the facility and along a fire trail and road improvement areas within Site 300. The Neroly Formation paleontological locality within Site 300 is being assessed. The paleontological resources on Site 300 may have moderate research potential and may contribute data to aid paleoenvironmental reconstruction.

4.7.2.8 Socioeconomics

Socioeconomic characteristics addressed at LLNL include employment and regional economy, population, housing, and public finance. Employment and regional economy statistics are presented for the regional economic area that encompasses 22 counties in California around LLNL. Statistics for the remaining socioeconomic characteristics are presented for the ROI, a three-county area in which approximately 86 percent of all LLNL employees reside: Alameda County (57 percent), Contra Costa County (13 percent), and San Joaquin County (16 percent). There are no other counties where more than 3 percent of LLNL employees reside. Figure 4.7.2.8-1 presents a map of counties and selected cities composing the LLNL regional economic area and ROI. Supporting data are presented in appendix D.

Regional Economy Characteristics. Selected employment and regional economy statistics for the LLNL regional economic area are summarized in figure 4.7.2.8-2. The civilian labor force in the regional economic area grew a total of 26 percent between 1980 and 1990, an average annual growth rate of 2.6 percent. Total regional economic area employment in 1994 was 4,068,974, and the unemployment rate was 7.6 percent. In comparison, state unemployment was 8.6 percent. Total personal income in the regional economic area in 1993 was $454 billion, and per capita income was $25,179. State per capita income in 1993 was $21,894.

As shown in figure 4.7.2.8-2, the LLNL regional economic area and the State of California have similar employment patterns with the manufacturing, retail trade, and services sector providing almost the same proportion of nonfarm employment in both regions. The service sector accounts for the largest share of nonfarm private sector employment in both California (32 percent) and the region (38 percent).

Population and Housing. In 1992, population in the ROI totalled 2,652,248. The ROI population

increased 26 percent between 1980 and 1992 (about 2 percent annually), a somewhat slower rate of increase than the state population growth of 31 percent (approximately 2.5 percent annually) during the same period. Total population increases within the ROI ranged from over 18 percent (about 1.5 percent annually) in Alameda County to about 45 percent (3.8 percent annual growth) in San Joaquin County during the same period.

The number of housing units in the ROI increased 18 percent during the 1980s (1.8 percent annually). Increases in the number of housing units in the ROI counties ranged from 13 percent (1.3 percent annually) in Alameda County to 25 percent (2.5 percent annually) in Contra Costa County. These growth rates compare to the 21-percent increase in housing units in California during the same period. In 1990, the regional homeowner vacancy rate averaged 1.6 percent, and the rental vacancy rate averaged 5.6 percent. These vacancy rates were comparable to the homeowner and rental vacancy rates for the entire state. Figure 4.7.2.8-3 summarizes population and housing trends for the LLNL ROI.

Public Finance. Financial characteristics of the local jurisdictions in the LLNL ROI that are most likely to be affected by the proposed action are presented in this section. The data reflect total revenues and expenditures of each jurisdiction's general fund, special revenue funds, and, as applicable, debt service, capital project, and expendable trust funds. School district boundaries may or may not coincide with county or city boundaries, but the districts are presented under the county where they primarily provide services. Major revenue and expenditure fund categories for counties, cities, and school districts are presented in appendix tables D.2.3-10 and D.2.3-11. Figure 4.7.2.8-4 summarizes 1994 local government revenues and expenditures. Fund balances, which are dollars carried over from previous years, are not included in figure 4.7.2.8-4. All jurisdictions assessed had positive fund balances.

4.7.2.9 Radiation and Hazardous Chemical Environment

The following section provides a description of the radiation and hazardous chemical environment at LLNL. Also included are descriptions of health effects studies, a brief accident history, and emergency preparedness considerations.

Radiation Environment. Major sources of background radiation exposure to individuals in the vicinity of LLNL are shown in table 4.7.2.9-1. All annual doses to individuals from background radiation are expected to remain constant over time. The total dose to the population would result only from changes in the size of the population. Background radiation doses are unrelated to LLNL operations.

Table 4.7.2.9-1.-- Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Lawrence Livermore National Laboratory Operations

Source	Committed Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[26]	
Cosmic and cosmogenic radiation	30
External terrestrial radiation	30

Internal terrestrial radiation	40
Radon in homes (inhaled)	200
Other Background Radiation [26, 27]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	365

Releases of radionuclides to the environment from LLNL operations provide another source of radiation exposure to individuals in the vicinity of LLNL. The radionuclides and quantities released from LLNL operations in 1994 are listed in the *Environmental Report 1994* (UCRL-50027-94). The doses to the public resulting from these releases are presented in table 4.7.2.9-2. These doses fall within regulatory limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1994 report were used in the development of the reference environment's (No Action) radiological releases at LLNL in 2005.

Based on a dose-to-risk conversion factor of 500 cancer deaths per 1 million person-rem (5x10-4 fatal cancers per person-rem) to the public (appendix E), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from LLNL operations in 1994 is estimated to be 3.3x10-*8* . That is, the estimated probability of this person dying of cancer from radiation exposure associated with 1 year of LLNL operations is slightly greater than 3 chances in 100 million. (Note that it takes several years from the time of exposure to radiation for cancer to manifest itself.)

Based on the same conversion factor, 3.8x10-*4* , excess fatal cancers are projected in the population living within 80 km (50 mi) of LLNL from normal operation in 1994. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this national rate, the number of fatal cancers from all causes expected during 1994 in the population living within 80 km (50 mi) of LLNL was 12,000. This number of expected fatal cancers is much higher than the estimated 3.8x10-*4* fatal cancers that could result from LLNL operations in 1994.

Table 4.7.2.9-2.--Doses to the General Public from Normal Operation at Lawrence Livermore National Laboratory, 1994 (Committed Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Affected Environment	**Standard** [28]	**Actual**	**Standard**	**Actual**	**Standard** [28]	**Actual**

Maximally exposed individual (mrem)	10	0.065	4	0.0	100	0.065
Population within 80 kilometers29 (person-rem)	None	0.76	None	0.0	100	0.76
Average individual within 80 kilometers30 (mrem)	None	1.3x10-4	None	0.0	None	1.3x10-4

Workers at LLNL receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities.

Table 4.7.2.9-3 includes the average, maximum, and total occupational doses to LLNL workers from operations in 1994. These doses fall within radiological limits (10 CFR 835). Based on a dose-to-risk conversion factor of 400 fatal cancers per 1 million person-rem (4x10-4 fatal cancers per person-rem) among workers (appendix E), the number of excess fatal cancers to LLNL workers from operations in 1994 is estimated to be 0.0073.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Lawrence Livermore National Laboratory Environment Report-1994* (UCRL-50027-94). The concentrations of radioactivity in various environmental media (e.g., air and water) and in animal tissue in the site region (onsite and offsite) are also presented in the same reference.

Table 4.7.2.9-3.-- Doses to the Onsite Worker from Normal Operation at Lawrence Livermore National Laboratory, 1994

	Onsite Releases and Direct Radiation	
Affected Environment	**Standard**[31]	**Actual**[32]
Average worker (mrem)	None	2.1
Maximally exposed worker (mrem)	5,000	1,300
Total workers (person-rem)	None	18.3

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in sections 4.7.2.3 and 4.7.2.4.

Adverse health impacts to the public can be minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during

normal operation at LLNL via inhalation of air containing hazardous chemicals released to the atmosphere by LLNL operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Baseline air emission concentrations for hazardous air pollutants and their applicable standards are presented in section 4.7.2.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are compared with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in appendix E.

Exposure pathways to LLNL workers during normal operation may include inhaling the workplace atmosphere, drinking LLNL potable water, and possible other contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. LLNL workers are also protected by adherence to OSHA and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at LLNL are expected to be substantially better than required by standards.

Health Effects Studies. A study involving two groups of children and young adults under the age of 25 who were born in Livermore between 1960 and 1990 and lived in Livermore between 1960 and 1991 found no increased risk of leukemia or non-Hodgkins lymphoma. The study found a 2.4-fold increase in the risk of malignant melanoma in the children and young adults who lived in Livermore between 1960 and 1991 and a 6.4-fold increased risk of malignant melanoma for children born in Livermore between 1960 and 1991. No increased risk of any other type of cancer was found.

A joint study conducted by the California Department of Public Health and LLNL reported 19 cases of malignant melanoma between 1972 and 1977 among LLNL employees (Lancet 1981a: 712-716). No other cancers were increased among LLNL employees from 1969 to 1980 (WJM 1985a:214-218).

Hiatt and Fireman investigated the hypothesis that the increased incidence of malignant melanoma was due to a difference in medical care received by LLNL employees compared to non-LLNL employees of the same geographic area belonging to the same prepaid health plan (LLNL 1984c). The authors concluded that the sustained increase in melanoma incidence at LLNL is associated with an increased likelihood of being biopsied for pigmented skin lesions because the physicians caring for LLNL employees may be more aware of the potential malignancy of pigmented lesions than those caring for non-LLNL employees.

The most recent case-control study of malignant melanoma concluded that there was no association between occupational factors and the increased melanoma diagnosis among LLNL employees (LLNL 1994e). No clear explanation for the increased melanoma among LLNL workers has been provided. Increased awareness and enhanced surveillance are currently suspected. For a more detailed description of the studies and the findings, refer to appendix section E.4.7.

Accident History. Prior to 1960, there were no accidents at LLNL that had offsite impacts. Since 1960, there have been a number of accidents that have resulted in only negligible exposures to the public.

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response. The LLNL Emergency Preparedness Plan is designed to minimize or mitigate the impact of any emergency upon the health and safety of employees and the public.

4.7.2.10 Waste Management

This section outlines the major environmental regulatory structure and waste management activities for the Livermore Site and Site 300. A more detailed discussion of the ongoing Livermore Site and Site 300 waste management operations and the regulatory setting is provided in appendix section H.2.6.

DOE is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operation at the Livermore Site and Site 300, and is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for compliance with applicable requirements and financial penalties for nonachievement of agreed-upon milestones. These agreements have been reviewed to assure the proposed actions are allowable under the terms of these agreements.

EPA included the Livermore Site on the NPL on July 21, 1987, because of groundwater contamination primarily by solvents containing VOC and fuel hydrocarbons. DOE, EPA, and the State of California entered into a Federal Facility Agreement to serve as the interagency agreement required under CERCLA and *Superfund Amendments and Reauthorization Act* (SARA), Section 120. This Federal Facility Agreement applies to the Livermore Site only and establishes a procedural framework and schedule for conducting source investigations, continued sampling, monitoring, and remediation of groundwater at the site. The Federal Facility Agreement enhances interagency coordination and cooperation, minimizes duplication of analysis and documentation, expedites remedial actions with a minimum of administrative delays, and establishes a basis for a determination that DOE has completed the CERCLA, RCRA, and state requirements.

Site 300 was placed on the NPL in 1990 because VOCs were discovered in the regional aquifer underlying the site and because of the proximity of the contamination to private drinking water supplies. The EPA and Site 300 authorities agreed to combine RCRA and CERCLA restoration requirements under a single Federal Facility Agreement for Site 300. A Federal Facility Agreement covering cleanup activities at Site 300 was executed on June 29, 1992. This agreement addresses the presence of trichloroethylene (TCE) in soil, rock, and groundwater; HE compounds in the HE Process Area; and tritium in the Pit 7 complex and in the Building 850 Area.

Through its research activities at the Livermore Site and Site 300, LLNL manages five broad waste categories: TRU, low-level, mixed, hazardous, and nonhazardous wastes, some of which are classified. Because there is no TRU waste associated with any of the proposed activities at LLNL,

there is no discussion in this PEIS of TRU waste generation and management at LLNL. A discussion of the waste management activities associated with each of these waste categories follows.

Low-Level Waste. In 1994, the Livermore Site generated approximately 181 m^3 (47,800 gal) of liquid and 307 m^3 3) of solid LLW (LLNL 1995i:1). Solid LLW at the Livermore Site consists of gloves, absorbent paper, plastics, glass, and other solid materials contaminated with low-level radioactive materials. Wastewater from retention tank systems that exceeds site radiological discharge limits or any special limits established for that tank, and cannot be treated for discharge or released to the sanitary sewer, is treated as LLW. Smaller quantities of contaminated liquids may be accumulated in various sizes and types of containers. Nonreleasable wastewater in generator retention tank systems is pumped into portable tanks for treatment at the Wastewater Treatment Tank Farm at the Building 514 Facility. At the Area 514 Waste Treatment Facility, containerized and bulk radioactive liquid wastes are transferred into one of the six 7,003 L (1,850 gal) treatment tanks to be treated chemically. These tanks are used to treat both radioactive and mixed waste liquids. Following treatment, a sample is gathered by hazardous waste management personnel and analyzed by a certified analytical laboratory for pH, metals, gross alpha and beta activity, tritium, and other possible contaminants, as necessary (depending on the waste's description). If the review indicates that the contents of a treatment tank are below established sewer discharge limits, the liquid is released to the sanitary sewer.

The precipitate wastes from tank farm chemical treatments are filtered in the Dorr-Oliver unit by creating a filter cake (coating a rotating drum with a slurry of diatomaceous earth), depositing the precipitate on the absorbent filter cake, capturing the filtrate in a tank, removing and packaging the contaminated cake, and then either discharging the liquid filtrate to the sanitary sewer or retreating it. The filter cake is then stabilized. Liquid and solid radioactive wastes are processed or stored at Building 514 and 612 complexes.

In 1994, Site 300 generated approximately 463 m^3 (606 yd^3) of solid LLW (LLNL 1995i:1). Site 300 generates solid LLW from the detonation of test assemblies on firing tables. The debris from the detonation is contaminated with depleted uranium and, in some instances, thorium or tritium. LLW is packaged in approved waste containers and transported for staging on site, pending shipment to the Livermore Site or shipment directly to NTS for disposal.

Mixed Low-Level Waste. In 1994, the Livermore Site generated approximately 51 m^3 (13,470 gal) of liquid and 20 m^3 (26 yd^3) of solid mixed LLW (LLNL 1995i:1). Some of the generated liquid mixed LLW is treated at the Area 514 Wastewater Treatment Tank Farm prior to discharge to the sanitary sewer so that hazardous constituents and radionuclides are removed, and this wastewater can be discharged within the allowable limits of the sewer discharge permit. The residual solids from this treatment process contain such hazardous constituents as coolants and solvents used in machining operations, toxic metals, decontamination solutions, and dyes. Mixed LLW is treated or stored at the Area 514 Wastewater Treatment Tank Farm and Building 612 complexes located in the southeast corner of the Livermore Site. Mixed wastes generated by Site 300 are currently stored and will continue to be stored at the Livermore Site until DOE-approved disposal options are available. These options are outlined in the LLNL Site Treatment Plan. In 1994, Site 300 generated approximately 8 m*3* (2,100 gal) of liquid and 0.37 m*3* (0.48 yd*3*) of solid mixed LLW.

Hazardous Waste. The Livermore Site and Site 300 presently operate five hazardous waste management facilities: Area 514, Area 612, Building 693, and Building 233 container storage unit are

at the Livermore Site. Building 883 is at Site 300. The Area 514 and Area 612 facilities contain treatment and storage units for hazardous and mixed wastes. The Building 693 facility is currently a container storage unit for hazardous waste and limited flammable mixed waste, pending analysis. The Building 233 container storage unit is currently used to store mixed, low-level, and TRU waste. Building 883 is used for hazardous wastes only.

In 1994, approximately 342 m^3 (90,350 gallons) of liquid and 237 m^3 (310 yd*3*) of solid hazardous wastes were generated at the Livermore Site (LLNL 1995i:1). Waste Management Facility operations at the Livermore Site are subject to Federal, state, regional, and local environmental requirements. Hazardous waste operations at the Livermore Site include the safe and proper handling, treatment, packaging, storage, and shipment of all hazardous waste generated by the site. The Livermore Site hazardous waste management units operate under RCRA interim status with an approved Part A Permit that was submitted December 16, 1991. A revised Part A Permit has been submitted to the state, while the Part B application submitted on January 17, 1992, undergoes processing by the State of California. Hazardous wastes are generated by the numerous R&D activities conducted throughout the facilities. Storage areas for nonradioactive and radioactive (or mixed) wastes are located at the Area 612 Facility yard. Wastes that contain PCBs and other wastes regulated by the TSCA are stored in Building 625. The nonradiological hazardous waste consists of ignitable, reactive, corrosive, toxic, and biohazardous waste (such as very dilute carcinogens and small animal carcasses) generated in biomedical and environmental research. Liquid hazardous waste contained in carboys may be pumped into drums that are stored, pending offsite transportation. The solid chemical wastes are packaged in drums and temporarily stored. The waste is then packaged according to DOT regulations. A commercial waste handler transports the liquid and solid hazardous waste drums to RCRA-permitted treatment, storage, and disposal facilities.

Building 693 was constructed in 1987. The California Department of Toxic Substances Control approved operation of this chemical waste storage facility in early 1991 under interim status standards. Building 693 began operation in 1992 and is used to store containerized RCRA-, TSCA-, and California-only regulated waste and limited flammable mixed waste, pending safety analysis.

Liquid waste and wastewaters are accumulated in retention tanks, carboys, or drums at the respective source locations throughout the Livermore Site. There, the materials are sampled and analyzed, and the determined waste contaminant levels are compared to the Livermore Site and city of Livermore discharge limits. If the levels of contaminants are below the regulatory limits, the material is released to the sanitary sewer. Industrial wastewater that contains constituents at concentrations greater than allowed by the city of Livermore discharge limits is managed as hazardous waste.

In 1994, Site 300 generated 111 m^3 (29,320 gal) of liquid and 46 m^3 (60 yd^3) of solid hazardous wastes (LLNL 1995i:1). Hazardous waste generated at Site 300 can be broken down into three general categories: explosives, analytical chemicals, and industrial wastes. The generation of solid and liquid hazardous waste varies with the number and type of experiments being conducted at any given time at Site 300. HE wastes are treated at the Building 829 complex, an open burn facility used for thermal treatment of these wastes. This facility will be operated until a new explosives waste treatment facility is permitted and operational as stated in a 1993 compliance order between LLNL, DOE, and the State of California. Site 300 hazardous wastes are stored in Building 883, a RCRA-permitted storage facility, before transfer to the Livermore Site waste management facilities. Generally, wastes are stored up to 1 year before shipment to the Livermore Site. Hazardous wastes are shipped through licensed commercial transporters to various offsite commercial RCRA-permitted treatment, storage, and disposal facilities.

The newly redesigned Decontamination and Waste Treatment Facility will replace and upgrade current waste management facilities presently used to process, treat, and store hazardous, radioactive, and mixed wastes. The Decontamination and Waste Treatment Facility would receive Livermore Site-generated medical, hazardous, LLW, and mixed LLW for consolidation, processing, treatment, and packaging before shipment and disposal offsite at commercial RCRA-permitted facilities.

The explosives waste storage facility project will convert five existing explosives storage magazines for the storage of explosives wastes. A new prefabricated metal building, to be located in a previously paved area, will be used for storing explosives-contaminated solid wastes (including packing material, discarded paper, and plastic labware) and ash from thermal treatment processes. Each of the five earth-covered magazines will be capable of storing specified weight limits of explosives, depending on the explosives waste types present.

Nonhazardous Waste. In 1994, the Livermore Site generated approximately 6,425 t (7,082 tons) of solid nonhazardous wastes (LLNL 1995i:1). Solid, nonhazardous wastes generated consisted of paper, plastics, glass, organic, and other wastes. The Livermore Site does not have onsite solid waste disposal facilities. Solid wastes are collected in dumpsters and other similar containers in such a manner as to assure that they do not contain hazardous or radioactive wastes and are transported to the Vasco Road Landfill for disposal.

In 1994, Site 300 generated approximately 315 m^3 (412 yd^3) of solid nonhazardous wastes (LLNL 1995i:1). The sources of solid, nonhazardous waste on Site 300 include office and laboratory refuse, construction debris, and landscape clippings. Solid, nonhazardous waste generated at Site 300 is transported to the Corral Hollow Sanitary Landfill, approximately 4 km (2.49 mi) east of Site 300 on Corral Hollow Road.

Medical wastes generated at the Livermore Site consist of biohazardous waste and sharps wastes. In 1994, approximately 2 m^3 (3 yd^3) of solid medical wastes were generated. Infectious wastes from the Biomedical Sciences Division are autoclaved in Building 365 to sterilize prior to disposal as sanitary waste, while sharps (e.g., needles, blades, and glass slides) waste is sent to an offsite commercial RCRA-permitted incinerator following sterilization.

Medical wastes at Site 300 are generated at the Medical Facility, Building 877. In 1994, approximately 2 m^3 (528 gal) of liquid and 2 m^3 (3 yd^3) of solid medical wastes were generated (LLNL 1995i:1). These wastes are managed in accordance with established LLNL procedures for handling medical wastes and are transported to the Livermore Site, where they are autoclaved at Building 365. The sterilized materials are then disposed of as sanitary waste.

For 1994, the Livermore Site generated approximately 456,000 m^3 (120,460,000 gal) of sanitary wastewater (LLNL 1995i:2). If sanitary wastewater generated by operations exceed permissible discharge limits and is treatable using permitted Livermore Site waste treatment units, the water is processed to meet the release criteria and then monitored as it is discharged to ensure that permissible discharge limits are not exceeded. These wastes enter the city of Livermore's sewer system and are then processed at the city of Livermore Water Reclamation Plant. The treated sanitary wastewater is piped to San Francisco Bay for discharge, except for a small volume that is used for summer irrigation of the municipal golf course adjacent to the Livermore Water Reclamation Plant. Sludge from the treatment plant is disposed of in offsite landfills.

When wastewater is discharged to the sewer system, it combines with sewage from SNL, Livermore. To protect the Livermore Water Reclamation Plant and to minimize any cleanup that might become necessary, the Livermore Site has an onsite sewage diversion and retention system that is capable of containing approximately 775,000 L (200,000 gal) of potentially contaminated sewage until it can be analyzed and appropriate handling methods implemented. If the liquids cannot be processed for discharge, they are packaged for treatment or disposal at an offsite facility. Treatment residues, or solids generated from the treatment process, are also packaged for treatment or disposal at an offsite facility.

In 1994, Site 300 generated approximately 4,420 m^3 (1,167,600 gal) of sanitary wastewater (LLNL 1995i:2). Sanitary wastewater generated within the General Services Area at Site 300 is discharged to an onsite sewer lagoon. Other more remotely located buildings on Site 300 are serviced by septic systems and leach fields. Industrial wastewaters are contained in retention tanks and analyzed, and their proper disposition determined. These wastewaters may be shipped to the Livermore Site for treatment, then discharged to the sanitary sewer system or shipped directly to an offsite treatment and disposal facility. The nonhazardous rinsewater from the HE machining, pressing, and formulation processes are disposed of by surface evaporation from two ponds.

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[1] Federal standard.

[2] State standard.

[3] No monitoring data available, baseline concentration assumed to be less than applicable standard/threshold value.

[4] San Francisco Bay Area Air Quality Management District ambient concentration guide.

[5] No standard. Source: 40 CFR 50; CA EPA 1993a; LLNL 1995i:1.

[6] For comparison only.

[7] Storm effluent sampling location (SW corner of the site).

[8] Storm effluent sampling location (NW corner of the site).

[9] Primary Drinking Water Regulations (40 CFR 141).

[10] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).

[11] DOE's Derived Concentration Guides for water (DOE Order 5400.5). Values are based on a committed effective dose equivalent of 100 mrem per year; however, because the drinking water maximum contaminant level is absed on 4 mrem per year, the number listed is 4 percent of the Derived Concentration Guides.

12 National Secondary Drinking Water Regulations (40 CFR 143).

13 No range could be provided; based on one sampling event. NA - not applicable. Source: LLNL 1994a.

14 For comparison only.

15 Stormwater runoff sampling location along the Arroyo Seco.

16 National Primary Drinking Water Regulations (40 CFR 141).

17 Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).

18 National Secondary Drinking Water Regulations (40 CFR 143). NA - not applicable.b Source: LLNL 1994a.

19 For comparison only.

20 Onsite monitoring well near Pit 1.

21 Onsite monitoring well near Pit 7.

22 Onsite monitoring well near HE Processing Area.

23 National Primary Drinking Water Regulations (40 CFR 141), maximum contaminant level.

24 Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).

25 DOE Derived Concentration Guide for drinking water (DOE Order 5400.5). Values are based on a committed effective dose of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the Derived Concentration Guide. NA - not applicable; mg/L - milligrams per liter; pCi/L - picocuries per liter. Well locations are shown in figure 4.7.2.4-1. Source: LLNL 1994a.

26 Source: LLNL 1994a. Value for radon is an average for the United States.

27 NCRP 1987a.

28 The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (58 FR 16268).

29 In 1994, this population was approximately 6 million.

[30] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site. Source: LLNL 1994a.

[31] 10 CFR 835. DOE's goal is to maintain radiological exposure as low as reasonably achievable.

[32] Source: LLNL 1994a. The number of badged workers in 1994 was approximately 8,700.