A.3.6 Nonnuclear Fabrication

The nonnuclear fabrication function provides the capability to fabricate nonnuclear components and perform nonnuclear component surveillance. Nonnuclear component products and/or processes fall within the groupings of those manufactured onsite and those procured. Several common subgroups have been identified:

- System Level: e.g., firesets and radars
- Electrical Components: e.g., integrated circuits and semiconductors, interconnect cables, and passive components
- Mechanical Components: e.g., radio frequency and multipin connectors, Rolamites, actuator assemblies, and reservoirs and valves
- Materials and Explosives: e.g., nuclear grade steel and molded plastic parts

The following discussion briefly describes the site alternatives for the nonnuclear fabrication mission:

Kansas City Plant. This alternative consists of three major factories involved in electronics and mechanical and engineered materials product lines, as well as outsourcing some components. KCP would downsize but maintain all of its current missions, reducing the KCP footprint to 167,000 m^2 (1.8 million ft^2) for DP activities from the current 297,000 m^2 (3.2 million ft^2). Estimated start would be in April 1998 with steady-state operation proposed in October 2003.

Los Alamos National Laboratory. This alternative is based on the use of existing facilities which are organized into a plastics facility, a pilot plant, a detonator facility, and a reservoir/valve/steel facility. The mission would be to provide high energy detonator inert components and fabrication of reservoirs, valves, and nuclear grade steel. Construction could begin in fiscal year 2000 with steady-state operation starting in fiscal year 2003.

Lawrence Livermore National Laboratory. This alternative has LLNL fabricating nuclear system plastic components, instead of LANL. The LLNL nonnuclear manufacturing facility would provide the plastic components and polymers currently produced at KCP, including filled and unfilled molded parts; syntactic, rigid, and flexible foam parts; composite structures; and specialty polymers currently produced at the KCP pilot plant. The 7,200-m^2 (77,840-ft^2) facility would be housed in five existing buildings in a limited access area at LLNL. Construction would begin in fiscal year 1998 with steady-state operation starting in fiscal year 2003.

Sandia National Laboratories. This alternative would transfer the majority of current KCP missions to SNL, except for nuclear system plastic components and high energy detonator inert components. SNL could also fabricate reservoirs, valves, and nuclear grade steel instead of LANL. This alternative requires both modification of existing facilities and construction of new facilities. Depending on the specific approach, total area affected would range from *56,100 to 63,200* m^2 (605,000 to 680,000 ft^2), new construction would range from 33,900 to 58,100 m^2 (365,000 to 625,000 ft^2), and modifications would range from 5,000 to 22,000 m^2 (55,000 to 240,000 ft^2). Construction would begin in the first quarter of fiscal year 1998 with steady-state operation starting in the first quarter of fiscal year 2004.

A generic set of products and services required to produce a typical bomb or re-entry warhead was defined to provide a common basis for estimating. Current program look-alikes were established to

determine the standard hour content of manufactured product, productive material costs, and the cost of procured components and services. Minimum quantities per year were developed to maintain a production capability for "in-house" manufactured product.

A make-buy determination was made for each product or service (see table A.3.6-1). KCP, SNL, LANL, and LLNL used the make-buy analysis to define the manufacturing area requirements, the direct and indirect support staff, the infrastructure support staff, and productive material cost required to support anticipated production requirements. The capacity of this basic capability supports all current schedules and anticipated retrofit needs.

Table A.3.6-1.-- Nonnuclear Fabrication Production Products Make/Buy Matrix

Product	**KCP Fabricate**	**KCP Procure**	**SNL Fabricate**	**SNL Procure**	**LANL Fabricate**	**LANL Procure**
WES/AF&F	X		X			
Firesets	X		X			
Printed wiring boards		X		X		
Printed wiring assemblies	X		X			
Multichip modules	X			X		
Hybrid microcircuits	X		X			
Housings (buy casting, forging, or bulk)	X	X	X	X		
Electronic components		X		X		
Radars (like firesets)	X		X			
Antennas		X		X		
Nose assemblies	X		X			
Electrical component assemblies	X		X			
Lasers and electro optics		X		X		
Programmers	X		X	X		
Filter packs		X		X		
Voltage regulators		X		X		
Accelerometers/ Environmental Sensing Devices	X		X			
Interconnect/junction boxes		X		X		
Preflight controllers	X		X			
Ready-safe switches		X		X		
Option select switches		X		X		
Coded switches	X		X			
Trajectory Sensing Signal Generators	X		X			

Piezoelectric motors		X		X		
Relays		X		X		
Output switches	X		X			
Category F - cases and electronics assemblies	X		X			
Timers	X	X	X	X		
Connectors		X				
Lightning arrester connectors	X		X	X		
Strong links	X	X	X	X		
Actuator assemblies		X		X		
Detonator cables	X				X	X
Interconnect cables		X		X		
Flat flex		X		X		
Fiber optic		X		X		
RF and coaxial		X		X		
High voltage		X		X		
CF round wire		X		X		
Valves	X		X		X	
Reservoirs	X		X		X	
Major mechanical parts	X	X	X	X		
Molded plastic parts		X		X		
Transfer molded		X		X	X 1	X 1
Compression molded		X		X	X 1	X 1
Injection molded		X		X	X 1	X 1
Machined		X		X	X 1	X 1
Cushions					X 1	
RTV	X				X 1	
Cellular silicone	X				X 1	
Foam supports	X		X		X 1	
Syntactic supports	X		X		X 1	
Filled polymers	X				X 1	
Desiccants	X		X			
Getters	X		X			
Parachute assemblies		X		X		
Hand T gear		X		X		
Trainer hardware and kits		X		X		
Retrofit kits		X		X		
D/855	X		X			

Joint test assemblies	X	X	X	X		
Transducers/detectors	X	X	X	X		
Data and flight recorders	X	X	X	X		
Special design hardware	X	X	X	X		
Commercial hardware		X		X		
Transportation Safeguards Division-Safe Secure Trailers	X	X	X	X		
Trailers	X	X	X	X		
Escort vehicles	X	X	X	X		
TC firing systems		X		X		
D/50 reprocessing	X		X			
Services-DOE and/or product required						
Test equipment field support	X		X			
Storage	X		X			
Testers	X		X			
Tools	X		X			
Gauges	X		X			
Data/records	X		X			
Material	X		X			
Boron reclamation/certifi-cation/storage	X				X	
Polymer pilot facility	X				X 1	
Cellular silicone compounding	X				X 1	
Classified automated data processing	X		X			
Logistics and manufacturing center	X		X			
Test equipment maintenance	X		X	X		
Transportation containers	X	X	X	X		
Tool and gauge fabrication	X	X	X	X		
Tool and gauge design	X	X	X	X		
Test equipment design and fabrication	X	X	X	X		
SECOM	X		X			
Nuclear grade steel acceptance/storage	X		X		X	
Kirtland operations	X		X			

A.3.6.1 Downsize at Kansas City Plant

KCP provides most of the nonnuclear components for the current nuclear weapons stockpile. KCP can effectively support the future stockpile management missions of the nuclear weapons program through a major downsizing of the physical plant and the functions required to support the production mission. The plant was designed, sized, and organized around the mission and workload of the Cold War era, and thus is not appropriately structured to efficiently accomplish the reduced workload of the future. The consolidation of the physical plant would allow a much more efficient organizational approach to be implemented to provide required direct and indirect support functions. The downsized plant would be referred to as KCP II.

The proposed KCP II consists of changing the existing plant and operational approach in four major aspects: (1) physically reducing the size of the facility, (2) changing the approach to manufacturing from product-based to process-based, (3) reducing the support infrastructure appropriate for the right-sized operation, and (4) changing the basic organizational structure to focus directly on the core manufacturing mission.

The proposed KCP II concept was developed to accommodate current and future active stockpile needs. The KCP II facility is to provide, with a 3-year notice, any conceivable combination of components for 150 factory retrofits as well as 150 field retrofits per year on a single-shift basis. These requirements are in addition to limited-life component exchanges, the stockpile evaluation program, and the stockpile surveillance program (joint test assemblies and warhead rebuild) currently scheduled.

Currently KCP consists of approximately 297,000 m 2 (3.2 million ft 2) of space contained in three connected buildings: the Main Building, the Manufacturing Support Building, and the Technology Transfer Center (figure A.3.6.1-1). Much of this floor space is underutilized and very costly to maintain. Many of the production departments are staffed with only a few people because of the low workload in some production technologies. The KCP II proposal and earlier independent space consolidation initiatives 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 vacated of DP activities. All operations and support functions required for stockpile management would be accomplished within reduced floor space of the main buildings.

The KCP II proposal is based on the consolidation of similar processes in three separate production areas (the electronic, mechanical, and engineered materials factories) and several product-based departments.

Electronics Factory. The products described in this section consist of electronic systems and electrical subsystems that function within weapon systems. There are three process modules: microelectronics, interconnects, and final assembly. Table A.3.6.1-1 shows the major processes within each of the electronics modules and the product types produced by these procedures. Total production floor space requirement would be approximately 12,454 m 2 (134,000 ft 2).

Microelectronics . A significant portion of the microelectronics fabrication would be performed in an existing hybrid microcircuit production facility. This 2,970-m 2 (32,000-ft 2) facility is divided into a number of sub-areas. Some of these areas have unique cleanliness capabilities from Class 100 to Class 10,000. The facility is also designed to provide differing temperature and humidity controls, as required, for the various areas. The balance of the microelectronics fabrication would be performed 1,282 m 2 (13,800 ft 2) of the Electronics Factory Mezzanine.

Interconnects. The area for this work would occupy 2,304 m 2 (24,800 ft 2) of the Electronics Factory Mezzanine. It would include an environmentally controlled photo-imaging area and an etching area to support flat flex cables for detonator assemblies. The remaining areas would be temperature and humidity-controlled, consistent with traditional electronics manufacturing requirements.

Table A.3.6.1-1.-- Kansas City Plant II Electronics Factory Processes and Products

Process Module	Major Processes	Product Types
Microelectronics	Vacuum deposition	Leadless chip carriers
	Plating	Thick film networks
	Screen printing	Thin film networks
	Photo lithography	Multichip modules
	Beam lead bonding	Hybrid microcircuits
	Fine wire bonding	
	Soldering	
	Component placement	
	Hermetic sealing	
	Cleaning	
Interconnects	Manual soldering	Printed wiring assemblies
	Wave and drag soldering	
	Auto component placement	
	Component insertion	
	Robotic tinning and preforming	
	Cleaning	
	Electrical testing	
	Photo imaging	Flat flex cables
	Etching	Detonator cables and assemblies
	Laminating	
	Lead titanate processing	Lightning arrestor connectors
	Manual assembly	
Final assembly	Manual assembly	Nose assemblies
	Hand soldering	Radars
	Welding	Firesets
	Encapsulation	Arming, fusing, and firing assemblies
	Bonding	ECA's
	Cleaning	Programmers

	Electrical testing	Timers
		Controllers
		Trajectory sensing signal generators
		Code activated processes
KC ASI 1995a.		

Final Assembly. The area for this work would occupy 3,019 m *2* (32,500 ft *2*) and, with one exception, would also reside on the Electronics Factory Mezzanine. The one exception would be for nose assemblies, which would be built on the factory floor near the new microelectronics facility. The welding and encapsulation area would support all of the weapon electronics products, as well as some joint test assemblies, special electronic assemblies, and mechanical product requirements. Temperature and humidity controls for traditional electronics manufacturing would also be provided. Products currently fabricated in-house, but to be purchased as a result of KCP II consolidation are printed wiring boards, junction boxes, antennas, voltage regulators, interconnect cables (round coaxial wire, high voltage), ready-safe switches, filter packs, and option select switches.

Joint Test Assembly/Special Electronic Assembly Factory. Security, production, and quality requirements of the joint test assembly and special electronic assembly product lines are not conducive to integration with other factory areas. Products built within the joint test assembly and special electronic assembly are primarily electronics operations and use similar or identical processes. These are bonding, cleaning, coating, encapsulation, mechanical assembly, soldering, swaging, and electrical verification.

Since the joint test assembly mission supports weapons throughout their life in the stockpile, the product lines within the joint test assembly area are somewhat insensitive to changes in weapon production requirements. As a result, reductions in the joint test assembly area would not be as dramatic as in other factory estimates. For future capacity requirements, the joint test assembly operation would be sized to produce assemblies at a rate that would support stockpile evaluation schedules currently in planning for the enduring stockpile.

The current joint test assembly production area would shrink by 33 percent to 1,644 m *2* (17,699 ft *2*) (excluding stores and storage). The special electronics assembly manufacturing area would be reduced by 55 percent to 1,352 m *2* (14,550 ft *2*). The joint test assembly area would be relocated to the Electronics Factory Mezzanine, while the special electronics assembly operation would be downsized in place. The estimated reduction in floorspace would primarily result from the elimination of capital equipment, testers, and tooling that are unnecessary to support the baseline workload. No special environments or highly hazardous operations would be required as a part of the production processes.

The joint test assembly operation is a job shop environment which makes use of a very limited amount of highly automated assembly, cleaning, and soldering processes. Prior to the relocation of the area, the newer products requiring automated processes would be built. At the end of that period, related test equipment and capital equipment would be moved and requalified over an 8-month period. In the interim, the labor force would be directed to build those assemblies requiring only manual soldering and cleaning techniques. Phasing production by program and process would result

in a negligible increase in cost. Based on past precedent, a requalification of each product would be unnecessary since most production processes are manual and the quality of joint test assembly products is controlled primarily by the operator.

The planned special electronic assembly operation rearrangement would keep critical manufacturing equipment in place. Process requalifications would be unnecessary.

Mechanical Factory. The proposed Mechanical Factory would maintain most of the capabilities presently available with significantly reduced capacity. The factory is based on projected production rates for reservoirs, transportation safeguards division products, and a small quantity of other unscheduled production requirements. This workload exercises key factory capabilities and maintains the ability to support currently unscheduled stockpile replacement product. Total productive floor space requirement would be 20,900 m 2 (225,000 ft 2).

Table A.3.6.1-2.-- Kansas City Plant II Alternative Mechanical Factory Products

Area	Products
Transportation safeguards products	Safe secure trailer/safeguards transport roadworthy refurbishment
	Safe secure trailer/safeguards transport retrofit/upgrades
	Safe secure trailer decommissioning
	Escort vehicle production
	Miscellaneous trailer production/repair
Metal machining	*Metal parts to support:*
	Mechanical assembly
	Electrical assembly
	Joint test assembly
	Cases and structural parts (limited)
Sheet metal and support processes	*Sheet metal parts to support:*
	Mechanical assembly
	Electrical assembly
	Liners and housings
	Support processes:
	Plating
	Painting
	Heat treatment
Mechanical welding	Support of mechanical assembly and sheet metal
Model shop/tool support	Tool repair and emergency fabrication
	Capability for prototype and evaluation hardware

KC ASI 1995a.

The workload mandates the consolidation of several previously separate manufacturing departments. The rearrangement consolidates all general machining processes in a common area. These consolidations allow for enhanced utilization of floor space, equipment, and personnel. Table A.3.6.1-2 lists mechanical factory products.

Engineered Materials Factory. The Engineered Materials Factory is designed to accommodate the minimum manufacturing capabilities required to support current and anticipated weapon program needs for all nonmetallic products. Basic processing capabilities have been retained to produce the following product families: polyurethane foam supports, syntactic foams, cushions, filled polymers, secure container assemblies, desiccants and getters, nonmetallic machining, and the polymer pilot plant. The minimum complement of manufacturing equipment to produce these products was determined and each production area sized appropriately.

Current manufacturing floor space of 11,241 m^2 (121,000 ft^2) within the main building would be reduced by more than 34 percent to 7,350 m^2 (79,150 ft^2). The polymer plant, a stand-alone facility used to produce unique materials not available from commercial suppliers, would not be reduced. Individual modules are described below:

- Compounding-164 m^2 (1,767 ft^2): This area supports the compounding of polymeric materials for urea-filled cellular silicone cushion material and metal-filled polymers for fabrication.
- Foam molding-492 m^2 (5,300 ft^2): Specially formulated polyurethane materials are mixed, poured, and cured to form structural parts for component packaging.
- Pressing--2,075 m^2 (22,335 ft^2): This facility molds-to-size all cushion and filled polymer products. Press capacity ranges from 9 to 1,814 t (10 to 2,000 tons).
- Machining--823 m^2 (8,864 ft^2): This environmentally controlled temperature and humidity area provides the capability to machine all nonmetallic products to their final configuration. Fabrication of syntactic foam products is also accomplished in this area.
- Assembly--2,404 m^2 (25,881 ft^2): This area supports lay-up, wrapping, and impregnating capabilities to manufacture secure container assemblies. Desiccant and hydrogen getter materials are blended, formed, and assembled in this facility.
- Polymer production--1,394 m^2 (15,000 ft^2): This external facility provides the polymer reactor capability to blend polyurethane materials that are unavailable from commercial suppliers. This facility has the capability to repackage bulk material into smaller unit quantities for production use.

Special environmental requirements were defined for machining, foam molding, and secure container assemblies, and appropriate areas were sized within the capability footprint of each module. Special security classification needs of secure container assemblies, cushion, and filled polymers have been considered and sufficient isolation provisions have been incorporated into the new factory concept.

Outsourcing Kansas City Plant-Made Products. A key tactic of the KCP II alternative is to aggressively pursue the outsourcing of products currently manufactured within KCP. KCP currently maintains most of the manufacturing technologies required to support weapons production. Anticipated reductions in production schedules and funding will no longer support maintaining all of these technologies in-house. Outsourcing is the preferred alternative as product designs become more

compatible with commercial industry capabilities. Products to be outsourced are antennas, interconnect cables, retrofit kits, filter packs, molded plastic parts, trainer hardware, voltage regulators, parachute assemblies, piezoelectric motors, junction boxes, handling equipment, TC firing sets, ready-safe switches, test gear, printed wiring boards, option select switches, trainer kits, lasers/electro-optics, and actuator assemblies.

Facilities modification to establish the KCP II configuration would take approximately 4 years. The following list describes the facility modification required to accomplish the proposed plant consolidation:

- Design and construction of standard manufacturing facilities
- Installation of modular clean rooms
- Design and construction of a fire-rated wall separating DOE from other site occupants
- Installation of heating, ventilation, and air conditioning systems and controls
- Extension of existing utility systems for chilled water, steam, sanitary, and industrial drains, and other mechanical and electrical services
- Site preparation, modification, and installation of walls and partitions, floor and ceiling finishes, security and fire protection features, and material handling equipment
- Rearrangement of existing operations and relocation of production equipment

Materials/resources consumed during KCP II construction are listed in table A.3.6.1-3. Emissions during construction/plant reduction would be negligible. The numbers of KCP II alternative construction workers required for construction/plant reduction can be found in table A.3.6.1-4.

Table A.3.6.1-3.-- Kansas City Plant II Construction/Plant Reduction Materials/Resources Requirements

Material/Resource	Total Consumption	Peak Demand
Electricity	Negligible	Negligible
Concrete (m^3)	286	
Structural steel (t)	220	
Water	*Negligible*	
KC ASI 1995a; KCP 1995a:2.		

Table A.3.6.1-4.-- Kansas City Plant II Construction/Plant Reduction Construction Workers

Employees	1998 Year 1	1999 Year 2	2000 Year 3	2001 Year 4	Total

Total craftworkers	87	162	104	40	393
Construction management and support staff	15	25	18	8	46
Total Employment	102	187	122	48	459
KC ASI 1995a.					

KCP is completing an extensive renovation and upgrade of the plants major utility systems through the facilities capabilities assurance program. KCP has upgraded the high voltage electrical distribution systems including the replacement of approximately 50 substations and switchgear and 13,800 volt cables. In addition, the majority of the roof mounted air-handling units, dehumidification units, controls and duct work, chillers and cooling towers at the west boilerhouse have been replaced. Sprinklers and fire main systems have also been upgraded to provide continued reliable fire protection for KCP. KCP manages two boiler and chiller sites on a 7-day-per-week, 24-hour-per-day basis. These locations provide chilled water, steam, and compressed air for KCP and the other Federal agencies occupying the site.

Taking the renovation and upgrade activities into account, downsizing and reconfiguring the plant for KCP II would have no impact on the utility system capacities. KCP II alternative surge operation utility requirements are shown in table A.3.6.1-5.

Table A.3.6.1-5.-- Kansas City Plant II Nonnuclear Fabrication Surge Operation Annual Utility Requirements

Utility	Consumption	Peak Demand 2
Electricity	225,000 MWh	30 MWe
Liquid fuel (L)	0	
Natural gas 3 (m *3*)	18,900,000	

Raw water (dry site) (L)	1,340,000,000	

KCP II alternative operation annual chemical requirements are listed in table A.3.6.1-6, and KCP II alternative surge operation emissions are listed in table A.3.6.1-7.

Table A.3.6.1-6.-- Kansas City Plant II Nonnuclear Fabrication Surge Operation Annual Chemical Requirements

Chemical	Quantity
Nitrogen	
Gas (m *3)*	3,270
Liquid (L)	14,900,000
Argon	
Gas (m *3*)	4,830
Liquid (L)	236,000
Carbon Dioxide	
Gas (m *3)*	322

Liquid (L)	122,000
Hydrogen	
Gas (m *3)*	0.1
Helium	
Gas (m *3)*	883
Liquid (L)	1,650
KC ASI 1995a.	

Table A.3.6.1-7.-- Kansas City Plant II Nonnuclear Fabrication Surge Operation Annual Emissions

Pollutant	**Quantity (t)**
Acetone	0.32
Carbon monoxide	13.17

Chromium	<0.01
Cyanide	<0.01
Ethyl benzene	0.054
Formaldehyde	<0.01
Hydrochloric acid	0.018
Isopropyl alcohol	4.44
Methanol	0.009
Methyl ethyl ketone	0.14
Methyl isobutyl ketone	0.027
Particulate matter	1.03
Perc	0.29

Sulfur dioxide	0.35
Toluene	0.59
Toluene diisocyanate	<0.01
1,1,1-Trichloroethane	0.036
Trichloroethylene	3.82
Volatile organic compounds	13.05
Xylene	0.25
KC ASI 1995a; KCP 1995a:3.	

Waste Management. The solid and liquid nonhazardous wastes generated during modification activities would include concrete and steel construction waste materials and sanitary wastewater. The steel waste would be recycled as scrap material before completing construction. The remaining nonhazardous wastes generated during construction would be disposed of by the construction contractor. Sanitary wastewater would be processed in the sanitary wastewater system. Wood, paper, and metal wastes would be shipped offsite to a commercial contractor for recycling. Hazardous wastes generated during construction would consist of such materials as waste adhesives, oils, cleaning fluids, solvents, and coatings. Hazardous waste would be packaged in DOT-approved containers and shipped offsite to commercial RCRA-permitted treatment, storage, and disposal facilities. No radioactive waste would be generated during construction.

Table A.3.6.1-8.-- Kansas City Plant II 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 4			
Liquid	None	None	None
Solid	None	None	None
Mixed Low-Level4			
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

The project design considers and incorporates waste minimization and pollution prevention. To facilitate waste minimization, where possible, nonhazardous materials would be substituted for those materials that contribute to the generation of hazardous waste. Production processes would be configured with minimization of waste production given high priority. Material from the waste streams would be treated to facilitate disposal as nonhazardous wastes, where possible. Future D&D considerations have also been incorporated into the design.

Table A.3.6.1-8 presents the estimated annual waste volumes from the nonnuclear fabrication plant at Kansas City during construction and surge operations. Solid and liquid wastestreams are routed to the waste management system. Solid wastes would be characterized and segregated into hazardous or nonhazardous wastes, then treated to a form suitable for offsite disposal. Liquid wastes would be treated onsite to reduce hazardous/toxic elements before discharge or transport. All fire sprinkler water discharged in process areas is contained and treated as process wastewater, when required.

Transuranic Waste. The Nonnuclear Fabrication Facility at KCP would not generate any TRU waste.

Low-Level Waste. The Nonnuclear Fabrication Facility at KCP would not routinely generate any LLW.

Mixed Low-Level Waste. The Nonnuclear Fabrication Facility at KCP would not routinely generate any mixed LLW.

Hazardous Waste. Hazardous wastes generated by the Nonnuclear Fabrication Facility at KCP would consist of acidic and alkaline liquids, solvents, and oils and coolants. Processes such as plating, etching, electronic assembly, metals and plastics machining and forming, and wastewater treatment are the principal generators. Liquid hazardous wastes would be collected in DOT-approved containers and sent to an onsite hazardous waste accumulation area. The hazardous waste accumulation area would provide a 90-day staging capacity prior to shipment to an offsite commercial RCRA-permitted treatment, storage, and disposal facility, using DOT-certified transporters. After compaction, if appropriate, the solid hazardous wastes would be packaged in DOT-approved containers and sent to a hazardous waste accumulation area for staging, characterization, and packaging prior to shipment to an offsite commercial RCRA-permitted treatment, storage, and disposal facility using DOT-certified transporters.

Nonhazardous (Sanitary) Waste. Nonhazardous waste generated at the Nonnuclear Fabrication Facility at KCP primarily consists of liquid sanitary, nonrecyclable, nonhazardous solid sanitary, and industrial wastes. Liquid sanitary wastes would be collected by sewer pipe systems from most of the support buildings and discharged directly to the Kansas City municipal sanitary sewer system. Process wastewater is sent to holding tanks for treatment and recycled, where appropriate. Process rinsewater waste streams are routed to the industrial wastewater pretreatment facility for treatment and then discharged to the Kansas City municipal sanitary sewer system.

Nonhazardous (Other) Waste. One-pass cooling water, fire sprinkler water, water from air dryers and vacuum pumps, as well as stormwater from areas of KCP would be discharged through the Blue

River and Indian Creek NPDES outfalls.

A.3.6.2 Relocate to Los Alamos National Laboratory

Historically, LANL has designed nuclear weapons and has fabricated the development hardware to support the nuclear weapon design process. LANL has made a clear distinction between fabrication for production and fabrication for design agency requirements. At LANL production agency responsibilities would be separately managed. The LANL alternative would rely primarily on in-house production of nonnuclear components and services. Table A.3.6-1 shows the list of nonnuclear products and make-buy decisions. The following sections describe the nonnuclear fabrication products and processes that would be carried out at LANL.

Plastics, Detonators, and Pilot Plant Operations. Technologies currently in place at LANL, with the exception of parylene coating, large scale polymer pilot operations, cellular silicone compounding, and certain filled polymer molding, can support production of all components under consideration.

Generic descriptions of the products or processes to be transferred include inert components for high energy main charge detonators, inert components for high energy neutron generator detonators, blown and cellular silicone foams, polyurethane foams, silicone elastomer molding, composite molding, commodity material molding, filled silicone molding, and pilot scale synthesis of polymeric materials.

Due to the small scale and specialty nature of weapons components, most would be made internally. Materials that would most likely be procured include commodity molded materials. Polyurethane resin currently fabricated at the polymer pilot plant is made in relatively large lots, and, as such, may be procurable from outside vendors. In all cases, internal capability would be maintained to fabricate all materials and components. If internal capability to fabricate specialty items were lost, the technical risk of meeting scheduled or unscheduled production deadlines would be significantly increased. Additional processing capability would be required in the areas of polyurethane foam dispensing, intensive mixing, extruding and leaching of cellular silicone, flame spraying, and parylene coating. For pilot plant operations, additional processing capability would be required for large scale processing of up to 380 L (100 gal). All detonator flat cable processing capability is currently available; however, upgraded equipment would be required to better meet production requirements. High energy detonator fabrication capabilities would need to be installed.

Reservoirs and Valves. LANL has the capability for small scale fabrication for valves and reservoirs in support of R&D of new boost systems, NTS operations, and local hydrodynamic or other experimental testing. Generic descriptions of the products or processes to be transferred include the procurement, certification, and storage of all nuclear-grade materials needed by production. These materials include different alloys of stainless steel, beryllium, copper, aluminum, weld filler materials, and other specialty materials unique to boost system applications. These materials may take the form of raw billets, forging, partially machined parts, finished machine parts, subassemblies, and finished assemblies. Also included in this parts list are vendor purchased parts such as elastomer seals, metal seals, screws, and filters. Fabrication of boost systems includes the procurement of material stock, machining operations, mechanical and radiographic inspection, cleaning, welding, assembly, proof pressure testing, leak testing, volume measurement, packaging, storage, and shipment. As part of the product certification, shelf life storage units would be manufactured to represent the product and monitored throughout the stockpile life.

Facility Description. LANL occupies an area of 111,000 ha (274,000 acres) with 30 active TAs (figure A.3.6.2-1). Figures A.3.6.2-2 through A.3.6.2-5 show the detailed facility layout for project TAs. [figure A.3.6.2-3] [figure A.3.6.2-4]

The following facilities, with the specified installations/upgrades, would be used for nonnuclear production activities at LANL:

- *Plastics production.* TAs-16-302, -303, -304, -305, -306, and -307: New or transferred equipment would be installed in these facilities. Electrical system upgrades would be required in some of these facilities.
- *Reservoir and valve production.* TA-3-SM-39: Removal of existing machine tools and replacement with new or transferred machine tools would be required. No other upgrades would be necessary.
- *Detonator component manufacture.* TA-22-91: New or transferred equipment would be installed at this facility. Electrical systems upgrades would be required.
- *Large scale pilot plant polymer synthesis.* TA-16-340: New or transferred equipment would be installed at this facility. Electrical systems upgrades would be required.
- *Small scale pilot plant polymer synthesis operations.* TA-35-213; no additional installations or upgrades required.
- *Mold storage.* TA-16-332: no installations or upgrades required.

Table A.3.6.2-1 presents facility data for the nonnuclear fabrication missions at LANL.

Technical Areas-16-302, -303, -304, -305, -306, and -307. These buildings would contain the plastics production activities associated with the proposed production activities. Buildings 302, 304, and 306 are single story with equipment room basements. Buildings 303, 305, and 307 are single story. The buildings are each concrete-walled, roofed structures that currently house plastics-related production, fabrication, and storage functions. Each of the buildings is served by 480-volt power and each has existing process steam, vacuum, air, and ventilation systems required for plastics fabrication and manufacture. The proposed production activities would require that several types of new or transferred equipment (mixers, extruders, roll mills, presses, coaters, screeners, testing equipment, and quality assurance equipment) be installed in Buildings 303 through 307. Building 302 would be used for raw material storage and bonded material/product storage. Although the existing electrical power would accommodate the added equipment, power distribution panels and associated wiring would have to be upgraded in some facilities. The steam, ventilation, air, and vacuum systems would not require upgrades.

Technical Area-3-SM-39. This facility would contain the metal machining, inspection, packaging, and storage functions required for reservoir and valve production. The facility is a two-story (second floor is mezzanine), concrete-walled, roofed structure with steel beam construction. The facility was originally designed as and is currently used as a machine shop, with air ventilation systems required for metal machining. The proposed production activities would require that several types of new or transferred machine tools (lathes, mills, drills, grinders, welders, inspection/testing equipment) be installed. Although the existing electrical power would accommodate the added equipment, power distribution panels and associated wiring would have to be installed for the specific machines. Besides rearranging equipment and storage locations, no other upgrades would be required.

Technical Area-22-91. This facility would contain the inert detonator manufacture and assembly

operations. The facility is a single-story, block and concrete structure with joist/concrete roof that was originally designed for detonator fabrication and assembly. The proposed production activities would require that several types of new or transferred equipment be installed. Although the existing electrical power would accommodate the added equipment, power distribution panels and associated wiring would have to be installed for the specific equipment. No other upgrades would be required.

Table A.3.6.2-1.-- Los Alamos National Laboratory Nonnuclear Facilities

Facility	Number of Stories	Total Space (m 2)	Utilized Space 5 (m 2)	Construction Type
TA-3-SM-39	2	10,405 6	2,323	Concrete with steel beam
TA-16-302	1	566	566	Concrete walls/roof
TA-16-304	1	566	566	Concrete walls/roof
TA-16-306	1	566	566	Concrete walls/roof
TA-16-303	1	273	273	Concrete walls/roof
TA-16-305	1	273	273	Concrete walls/roof
TA-16-307	1	273	273	Concrete walls/roof
TA-16-332	1	929	929	Steel joist/metal sheet

TA-16-340	2	2,111 6	149	Concrete walls/roof
TA-22-91	1	2,002	2,002	Concrete walls/roof
TA-35-213	3	7,880	1,125	Concrete walls/roof

Technical Area-16-340. Bays 109 and 110 of this facility would contain the large scale pilot plant polymer synthesis. The building is a two-story (second floor is equipment room) concrete-walled, roofed structure with blowout walls originally designed for explosive synthesis operations. The proposed production activities would require that a reactor vessel, mixer heater, pulverizer, solvent recovery equipment, and storage area be located in the bays. New electrical service to the equipment would have to be installed. No other upgrades would be required.

Technical Area-35-213. This facility would contain the small scale plant polymer synthesis. The building is a three-story formed concrete structure with a joist/concrete roof. The proposed production activities would not require any modification or installations as all of the required equipment currently exists.

Technical Area-16-332. This facility would be used as a storage area for raw materials and/or components associated with the proposed production activities. The building is a single-story, steel-framed metal building. No upgrades or installations would be required.

Table A.3.6.2-2 presents a schedule for implementation of nonnuclear fabrication activities at LANL. Construction would consist of new or transferred equipment in existing facilities and upgrades to electrical systems within the proposed facilities. The proposed installations and modifications would occur over a 2-year period. The resources and raw materials would consist of only what would be required to install 50 pieces of equipment and to upgrade electrical systems. Materials/resources consumed during the entire construction phase are presented in table A.3.6.2-3.

Table A.3.6.2-2.-- Los Alamos National Laboratory Schedule of Activities for Nonnuclear Fabrication

Activity	Start	End
Research and development duration	1/96	1/97
Hazard/risk assessment, NEPA determination	1/96	1/98
Engineering design (conceptual, final)	1/97	1/00
Modifications/equipment installations	1/00	1/01

Mission transfer/qualification/ proof of operation	1/99	12/02
Steady-state operations	12/02	
Decontamination/decom-missioning or conversion	1/30	
LANL 1995c.		

Table A.3.6.2-3.-- Los Alamos National Laboratory Nonnuclear Fabrication Construction/Upgrade Materials/Resources Requirements

Material/Resource	Total Consumption	Peak Demand
Electricity	105 kWh	3.8kWe
Electrical wiring (m)	762	
Conduit (m)	3,050	
Water (L)	9,500	
LANL 1995c.		

Because the construction activities associated with the proposed activities would consist only of installation of equipment and upgrade of electrical systems, there would be no aerial emissions of criteria or other pollutants.

Only small quantities of nonhazardous solid and liquid wastes would be generated as a result of the equipment installation and electrical upgrade work required for the proposed activities. Table A.3.6.2-4 lists the total number of personnel that would be required to perform the installation/modification work. This includes only those actually involved with the work and does not include process development or design work. The number of employees listed are spread out over a 1-year period, and more than the listed quantity could be present at any time during the year (1.5 workers per year may consist of 3 workers for a 6-month period).

Table A.3.6.2-4.-- Los Alamos National Laboratory Nonnuclear Fabrication Construction Workers

Employees	2000	2001	Total
Total craftworkers	3.0	3.0	6
Construction (installation) management/support staff	0.25	0.25	0.5
Technical support personnel	2.0	2.0	4
Project support personnel	1.0	1.0	2
Total Employment	6.25	6.25	12.5
LANL 1995c.			

Table A.3.6.2-5 provides estimates of the electrical, steam, and water usage that would be added to facility surge operations due to the proposed action. Because all of the activities would occur in existing buildings, space heating loads and electrical loads from normal occupancy (lighting and ventilation) are not included. Raw water consumption includes added sanitary usage from increased personnel that would occupy the facilities due to the proposed activities.

It is noted that all of the facilities associated with the proposed activities are heated either by steam or by central gas heating systems. At the TA-16 facilities, steam is also used as a process heating method and for process washdown/cleaning activities.

Table A.3.6.2-5.-- Los Alamos National Laboratory Nonnuclear Fabrication Surge Operation Annual Utility Requirements

Utility	Consumption	Peak Demand 7

Electricity	525 MWh	0.23 MWe
Liquid fuel	None	
Natural gas	340	
Steam (m *3)*	95	
Raw water (L)	48,300,000	

Table A.3.6.2-6 lists the annual chemicals consumed during surge operation.

Table A.3.6.2-6.-- Los Alamos National Laboratory Nonnuclear Fabrication Surge Operation Annual Chemical Requirements

Chemical	Quantity
Raw materials/chemicals used for plastics formulation	38,600
Metals for valve/reservoir/detonator production (kg)	3,020
Machine tool cutting fluids/lube oils (kg)	511
Cleaning/developing fluids for detonator assembly (kg)	2,270

LANL 1995c.	

Emissions. None of the proposed activities would require discharge to existing NPDES-permitted outfalls. Although there would be a slight increase in once-through cooling water discharged from the steam plant to an NPDES outfall resulting from the slight increase in process steam usage, this is not considered to be a pollutant. Aerial emissions of combustion by-products from the slight increase in process steam usage are listed as annual surge operation emissions in table A.3.6.2-7.

Table A.3.6.2-7.-- Los Alamos National Laboratory Nonnuclear Fabrication Surge Operation Annual Emissions

Pollutant	Quantity (t)
Carbon monoxide	0.0002
Nitrogen oxides	0.0002
Particulate matter	0.00007
Sulfur oxides	0.000003
Volatile organic compounds	0.282
LANL 1995c.	

Waste Management. Small amounts of nonhazardous liquid and solid wastes would be generated as a result of the installation of equipment and upgrade of the electrical systems. No radioactive waste or hazardous waste would be generated during construction.

The project design considers and incorporates waste minimization and pollution prevention. Production processes would be configured with minimization of waste production given high priority. Material from the waste streams would be treated to facilitate disposal as nonhazardous wastes,

where possible. Future D&D considerations have also been incorporated into the design.

Table A.3.6.2-8 presents the estimated annual waste volumes from the Nonnuclear Fabrication Facility at LANL during modification activities and surge operations. Solid and liquid waste streams are routed to the waste management system. Solid wastes would be characterized and segregated into hazardous and nonhazardous wastes, then treated to a form suitable for offsite disposal or storage within the facility. Liquid wastes would be treated onsite to reduce hazardous/toxic characteristics before discharge or transport.

Transuranic Waste. The Nonnuclear Fabrication Facility at LANL would not generate any TRU waste.

Low-Level Waste. The Nonnuclear Fabrication Facility at LANL would not generate any LLW.

Table A.3.6.2-8.-- Los Alamos National Laboratory Nonnuclear Fabrication Waste Volumes

Category	Annual Average Volume Generated from Construction (m 3)	Annual Volume Generated from Surge Operations 8 (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 9
Solid	None	10	6 10
Nonhazardous (Other)			

Liquid	5 11	25 12	None
Solid	0.04	3 13	None

Mixed Low-Level Waste. The Nonnuclear Fabrication Facility at LANL would not generate any mixed LLW.

Hazardous Waste. Some hazardous wastes would be generated as a result of the Nonnuclear Fabrication Facility at LANL; however, no new hazardous waste streams would be generated. These wastes consist of liquid solvent wastes and solid beryllium wastes from machining operations. Liquid hazardous wastes would be collected in DOT-approved containers and sent to an onsite hazardous waste accumulation area. The hazardous waste accumulation area would provide a 90-day staging capacity prior to shipment to an offsite commercial RCRA-permitted treatment, storage, and disposal facility, using DOT-certified transporters. The solid hazardous wastes would be packaged in DOT-approved containers and sent to a hazardous waste accumulation area for staging, characterization, and packaging prior to shipment to an offsite commercial RCRA-permitted treatment, storage, and disposal facility using DOT-certified transporters.

Nonhazardous (Sanitary) Waste. Nonhazardous process wastes generated at the Nonnuclear Fabrication Facility at LANL consist of washdown and cleaning water containing soaps and other cleaning agents. These wastes would be discharged to the sanitary waste systems. Solid nonhazardous plastics waste and wastewater sewage sludge is disposed of in offsite industrial and sanitary landfills.

Nonhazardous (Other) Waste. Liquid nonhazardous wastes such as spent machine tool cutting fluids and spent lubricating oils will either be recycled or disposed of onsite or offsite by the LANL Waste Management Group. Solid nonhazardous wastes such as excess electrical wire, resins, and molds would also be generated. This waste would be salvaged, recycled, or disposed of offsite.

A.3.6.3 Relocate to Lawrence Livermore National Laboratory

Nonnuclear fabrication at LLNL would include production or procurement of all plastic components, polymers, and composite parts. Nearly all processes are currently, or have been, in operation at LLNL on the same scale as needed for the nonnuclear fabrication mission. The nonnuclear fabrication mission would be accomplished within 15 departments listed in table A.3.6.3-1.

Table A.3.6.3-1.-- Lawrence Livermore National Laboratory Existing Nonnuclear Fabrication Departments

Department Number	Function

1	Compression molding
2	Transfer molding
3A	Cellular silicone foam
3B	Brown silicone foam
4	Injection molding
5	Polyurethane foam molding
6	Casting and encapsulation
7	Machining
8	Composite fabrication
9	Repackaging
10	Polymer synthesis
11	Receiving
12	Packaging/shipping
13	Document control
14	Quality control
15	In-process material handling
LLNL 1995f.	

Nonnuclear fabrication would take place at the Livermore Site as shown in figure A.3.6.3-1. The fabrication, including polymer synthesis, would be confined to a consolidated area consisting of five adjacent buildings as shown in figure A.3.6.3-2.

Departments 1, 2, 3B, 4, 6, 7, 8, and 9 currently exist in dedicated facilities within the B231 complex at LLNL. Equipment for Department 5 is available but would be relocated to B131 in an existing low-relative-humidity operations area. Relative-humidity-sensitive and precision machining operations would also be located in this area. Department 3A would most likely be a scaled down version of the existing process and would be located in area B231. Department 10 would be an entirely new process which would be located in B232. Large scale storage of incoming and finished product would be accomplished in B131 adjacent to the Department 5 facility. Receiving inspections would be accomplished in B223. Finished product packaging and short-term storage would be in B227. In-process storage would be in the high bay area on B231. Support offices and in-process quality control would also be located in B231.

The process/products included in the LLNL nonnuclear fabrication alternative are transfer molded parts, compression molded parts, injection molded parts, machined plastic parts, silicone cushion (all types), syntactic components, filled polymers, and polymer synthesis.

This alternative covers processes for fabrication of nearly all plastic nonnuclear components needed to meet nonnuclear fabrication requirements. There are a few components that can be obtained more cost effectively through procurement. Some very specialized plastic film and tubing parts for certain assemblies may more effectively be produced or procured by the agency producing the assembly. Synthesis of basic polymers is included to provide raw materials that are not commercially available.

Compression Molding. The compression molding process would be used to produce filled and unfilled, elastomeric or rigid, thermosetting components.

Existing roll mill capacity would be sufficient for all products except cellular silicone. Currently ceramic rolls are used for high purity instead of beryllium oxide rolls utilized at KCP. The beryllium oxide rolls would have to be transferred or a modification made to the process specifications to allow for other materials. An intermediate size roll mill and Banbury mixer for use with cellular silicone are included in capital equipment. Scales, preform cutting, and in-process storage are available.

The facility is capable of utilizing integrally heated or platen heated tools. Thus, existing tooling should be sufficient in all cases. Tooling would be stored in the B231 complex in the 1300 Wing.

There is very little transfer molding involved in this alternative. Diallyl phthalate electronic components would be procured by the agency needing the components. However, the capability would exist within the production facility.

Preforming would be done on existing compression or transfer presses located in Department 2. The dielectric heater would be transferred from the production agency or purchased new. Post cure can be accomplished in the current oven capacity at the facility. In-process trim and inspection would be accomplished in the same area used for compression molded parts. Overflow inspection capability would exist in room 1240.

Cellular Silicone Compounding. The current production process for cellular silicone compounding could either be scaled down to a more appropriate size or the equipment could be transferred from the current production agency. The most economical approach would be to scale this process down to a much smaller batch size. Similar parts were made 10 years ago in the existing equipment at LLNL. This equipment includes the Banbury mixer, compounding roll mills, and sheeting roll mills. Production levels dictate an equipment size in-between those at LLNL and KCP. The current proposal allows for scaling down the process; however, there is an area set aside in the B231 high bay for installation of KCP equipment. Another option would be to transfer the production agency equipment to LLNL. In that case, the compounding operations would be installed in the high bay of B231 in place of existing temporary structures.

The urea screening operation either would be transferred from the production agency or a new system of smaller capacity would be installed at LLNL. This equipment would be scheduled for B231, in a dedicated area in either case. Washing and drying operations would be located in B231 in a newly enclosed area in Wing 1200. Two washers would be transferred from KCP. A reverse osmosis water system would be installed in B232 and piped to the 1200 Wing of B231. A new drying oven would be purchased. Molding operations would be conducted in the compression molding department.

Blown Silicone Foam Molding. The current operation for blown silicone foam molding in department 3B utilizes equipment in the compression molding department. There is some ancillary equipment in place that is functionally identical to that used at KCP.

Injection Molding. The installed injection molding (Department 4) capacity at LLNL includes machines of up to 260-g (9-ounce) and 100-t (110-ton) capacity. The capability at KCP includes machines of this size and also 400, 740, 790, and 2,270 g (14, 26, 28, and 80 ounces). The need for this larger equipment would be evaluated as the requirement warranted. The machines at LLNL are in

excellent condition. The 100-t (110-ton) machine at LLNL utilizes dedicated computer control. This feature is very useful in a production environment when a variety of products are involved because of the rapid, error free setting of machine variables from stored programs. Large polymethylpentene blanks are currently made at KCP using the 2,270-g (80-ounce) injection molding machine in a specialized process that is somewhat similar to compression injection but on a very large scale. This process could be sent to an outside vendor if a change in grade of material could be approved. This would be the option of choice. However, there are two other options: install the 2,270-g (80-ounce) machine in the B231 high bay adjacent to existing injection molding facilities or qualify the process currently in use at LLNL for the production of large polymethylpentene castings.

Polyurethane Foam Molding. LLNL currently operates three machines in Department 5 that can be utilized for the polyurethane foam molding process. One is a resin transfer molding unit that can be modified for foam. This machine is extremely versatile and would be the machine of choice for most production.

This process would be located in Wings 1300 and 1400 of B131, less than 100 m (*328* ft) from the Central Process Area in B231. This is the location of preference since 10 percent relative humidity control is installed and operational. Foam and other relative humidity sensitive and precision machining operations would be collocated in the same wing. Much of that machining capacity is already installed. Existing tooling could be used in all cases. Tooling storage would be in an adjacent storage area.

Casting and encapsulation. Casting and encapsulation is a routine operation in the current Department 6 facility, and no significant changes are anticipated. Vacuum/pressure encapsulators are available. Existing tooling should be adequate in all cases. Tooling storage would be similar to that for compression molding.

Machining. Machining operations would be conducted in Department 7 in the B231 Machine Facility in Wing 1500. Composite machining would occur in Room 1019, B231. This room is currently dedicated to this type of machining and has the proper tooling, including diamond tools, and the proper high speed machining heads. HEPA filtration and high velocity dust extraction is built into this facility.

Low relative humidity and precision machining would occur in B131. The current facility can be humidity controlled to less than 10 percent relative humidity and has substantial matching and inspection capability in place. Certain specific machines may have to be relocated from other onsite locations or, if necessary, from KCP.

Composite Fabrication. There is only a small amount of composite fabrication needed for this alternative. These few parts can readily be fabricated in the current facilities, located in Department 8. The most sophisticated component is a carbon/phenolic part. The existing 318-t (350-ton) press has highly flexible bump cycle programming which can be utilized for fabricating this part.

Repackaging. Repackaging is a routine operation within the existing Department 9 facility. No additional changes would be required for this alternative.

Polymer synthesis. Polymer synthesis would be a new Department 10 operation at LLNL. Reactors of 190- and 380-L (50- and 100-gal) capacity and associated support equipment would be located in B232. Reactors, complete with a dedicated hot oil heating system, are included in capital equipment.

The units would be installed in the south portion of B232. This is an abandoned high pressure facility and is ideal for this operation. Items such as product dryers and precipitators would be transferred from KCP.

A list of materials and resources consumed during modification activities can be found in table A.3.6.3-2. A list of emissions produced during modification activities can be found in table A.3.6.3-3. A list of construction workers needed during the modification phase can be found in table A.3.6.3-4. A list of utilities consumed during surge operation can be found in table A.3.6.3-5. A list of the annual chemicals consumed during surge operation can be found in table A.3.6.3-6. A list of emissions produced during surge operations can be found in table A.3.6.3-7.

Table A.3.6.3-2.-- Lawrence Livermore National Laboratory Nonnuclear Fabrication Construction/Modification Materials/Resources Requirements

Material/Resource	Total Consumption	Peak Demand 14
Electricity	21 MWh	50 kWe
Fuel (L)	19,900	
Water (L)	79,500	
Concrete (m^3)	7.6	
Steel (t)	7.3	
Industrial gases (m^3)	7.5	

Table A.3.6.3-3.-- Lawrence Livermore National Laboratory Nonnuclear Fabrication Construction/Modification Emissions

Pollutant	Quantity (t/yr)
Carbon monoxide	3.08
Nitrogen oxides	1.09
Particulate matter	0.36

Sulfur dioxide	0.09
Volatile organic compounds	0.54
LLNL 1995f.	

Table A.3.6.3-4.-- Lawrence Livermore National Laboratory Nonnuclear Fabrication Construction/Modification Construction Workers

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Architectural design	0.14	0.35	0.43	0.35	0.14	1.4
Plant design	0.09	0.22	0.26	0.22	0.09	0.9
Project manager	0.09	0.22	0.26	0.22	0.09	0.9
Construction manager	0.13	0.31	0.38	0.31	0.13	1.3
Inspectors	0.13	0.31	0.38	0.31	0.13	1.3
Document clerk	0.01	0.03	0.04	0.03	0.01	0.1
Craftworkers	1.27	3.20	3.80	3.20	1.27	12.7
Total Employment	1.9	4.6	5.5	4.6	1.9	18.6
LLNL 1995f; LLNL 1995i:2.						

Table A.3.6.3-5.-- Lawrence Livermore National Laboratory Nonnuclear Fabrication Surge Operation Annual Utility Requirements

Utility	Consumption	Peak Demand 15
Electricity	108 MWh	0.095 MWe
Natural gases (m^3)	28,900	
Liquid fuel (L)	0	
Water (L)	3,790,000	

Table A.3.6.3-6.-- Lawrence Livermore National Laboratory Nonnuclear Fabrication Surge Operation Annual Chemical Requirements

Chemical	Quantity
Nitrogen	
Gas (m^3)	37.8
Liquid (L)	278,000
Argon	
Gas (m^3)	39.2
Liquid (L)	3,420
Carbon dioxide	
Gas (m^3)	2.35
Liquid (L)	1,760
Hydrogen	

Gas (m *3*)	0.04
Liquid (L)	0
Helium	
Gas (m *3*)	71.64
Liquid (L)	22.7
LLNL 1995f; LLNL 1995i:2.	

Table A.3.6.3-7.-- Lawrence Livermore National Laboratory Nonnuclear Fabrication Surge Operation Annual Emissions

Chemical	**Quantity (t)**
Acetone	0.066
Isopropanol	0.13
Methyl ethyl ketone	0.006
Toluene	0.006

LLNL 1995f.	

Waste Management. The solid and liquid nonhazardous wastes generated during modification activities would include concrete and steel construction waste materials and sanitary wastewater. The steel waste would be recycled as scrap material before completing construction. The remaining nonhazardous wastes generated during construction would be disposed of by the construction contractor. Uncontaminated wastewater would be used for soil compaction and dust control, and excavated soil would be used for grading and site preparation. Wood, paper, and metal wastes would be shipped offsite to a commercial contractor for recycling.

Hazardous wastes generated during construction would consist of such materials as waste adhesives, oils, cleaning fluids, solvents, and coatings. Hazardous waste would be packaged in DOT-approved containers and shipped off site to commercial RCRA-permitted treatment, storage, and disposal facilities. No radioactive waste would be generated during construction.

The project design considers and incorporates waste minimization and pollution prevention. Segregation of activities that generate radioactive and hazardous wastes would be employed, where possible, to avoid the generation of mixed wastes. Where applicable, treatment to separate radioactive and nonradioactive components would be performed to reduce the volume of mixed wastes and provide for cost-effective disposal or recycle. To facilitate waste minimization, where possible, nonhazardous materials would be substituted for those materials which contribute to the generation of hazardous or mixed waste. Production processes would be configured with minimization of waste production given high priority. Material from the waste streams would be treated to facilitate disposal as nonhazardous wastes, where possible. Future D&D considerations have also been incorporated into the design.

Table A.3.6.3-8 presents the estimated annual waste volumes from the Nonnuclear Fabrication Facility at LLNL during modification activities and surge operations. Solid and liquid waste streams are routed to the waste management system. Solid wastes would be characterized and segregated into nonhazardous or hazardous wastes, then treated to a form suitable for disposal or storage within the facility. Liquid wastes would be treated onsite to reduce hazardous/toxic elements before discharge or transport. All fire sprinkler water discharged in process areas is contained and treated as process wastewater, when required.

Transuranic Waste . The Nonnuclear Fabrication Facility at LLNL would not generate any TRU waste.

Low-Level Waste. The Nonnuclear Fabrication Facility at LLNL would not generate any LLW.

Mixed Low-Level Waste. The Nonnuclear Fabrication Facility at LLNL would not generate any mixed LLW.

Hazardous Waste. Hazardous wastes generated by the Nonnuclear Fabrication Facility at LLNL would consist of acetone, toluene/methanol mixture, toluene, and dimethyl formamide in aqueous solution. The toluene/methanol waste stream has been evaluated as a strong candidate for recycling by distillation to recover the high value solvent components. The distillation of this waste stream would result in the generation of distillation bottoms, which would be removed periodically and managed as a solid hazardous waste. Liquid hazardous wastes would be collected in DOT-approved

containers and sent to an onsite hazardous waste accumulation area. The hazardous waste accumulation area would provide a 90-day staging capacity prior to shipment to an offsite commercial RCRA-permitted treatment, storage, and disposal facility, using DOT-certified transporters. After compaction, if appropriate, the solid hazardous wastes would be packaged in DOT-approved containers and sent to a hazardous waste accumulation area for staging, characterization, and packaging prior to shipment to an offsite commercial RCRA-permitted treatment, storage, and disposal facility using DOT-certified transporters.

Nonhazardous (Sanitary) Waste. Nonhazardous waste generated by the Nonnuclear Fabrication Facility at LLNL primarily consists of process water and incidental water usage, and nonrecyclable, nonhazardous solid sanitary and industrial wastes. Liquid sanitary wastes would be collected by sewer pipe systems from most of the support buildings and discharged directly to the city of Livermore municipal sanitary sewer system. One of the projected waste streams, an aqueous solution of urea, will be sampled to establish a baseline of waste stream constituents, and directed to the sanitary sewer system. Process wastewater is sent to holding tanks for treatment and recycled where appropriate. Process rinsewater waste streams are pretreated and then discharged to the sanitary sewer system according to permit requirements and the city of Livermore Public Services Ordinance.

Table A.3.6.3-8.-- Lawrence Livermore National Laboratory Nonnuclear Fabrication Waste Volumes

Category	Annual Average Volume Generated from Construction (m^3)	Annual Volume Generated from Surge Operations [16] (m^3)	Annual Volume Effluent from Surge Operations (m^3)
Hazardous			
Liquid	0.08	7 [17]	3 [18]
Solid	0.15	None	0.2
Nonhazardous (Sanitary)			
Liquid	36	5,770 [19]	5,770 [20]

Solid	0.9	127 21	64 22
Nonhazardous (Other)			
Liquid	76	Included in sanitary	Included in sanitary
Solid	10	Included in sanitary	Included in sanitary

Nonhazardous (Other) Waste. The bulk of waste would be thermoplastic and cured thermoset materials and various fillers or reinforcements. LLNL is conditionally permitted in California to treat any unused thermosetting waste in order to make the waste nonhazardous. Stormwater from areas of LLNL is allowed to go in natural drainage channels.

A.3.6.4 Relocate to Sandia National Laboratories

Most products and services currently obtained from KCP would be obtained by SNL, which is located in New Mexico, through procurement from the commercial sector or through capabilities that would be developed internal to SNL. Procurement of products and services from the private sector would be the preferred alternative. Key nonnuclear product and process descriptions for items to be purchased are described in the following section.

System Level Products (Made up of more than one component to form a kit or system.)

Retrofit Kits . Retrofit kits would be assembled, stored, packaged, and shipped to various locations for repairing problems in weapons or upgrading weapon capabilities. Retrofit kits would be maintained in a bonded storage area, and when complete would be specially packaged and shipped to where they are needed. Sometimes specialty packaging would be done at the fabrication point within the plant.

Trainer Kits . Trainer kits are a package that may contain a variety of weapon components that may be hazardous or operationally irreversible in their realistic form but are functional in helping to teach the customer how to test, operate, or install a real component prior to actually doing so. Alternately, the kit may be used to teach the customer how to perform a weapon retrofit. The trainer kit may also contain tools, test devices, bolt packs, or similar hardware packs to perform tests or component replacement training. Trainer kits would be made in-house for components that are made in-house.

SECOM Relay Station. DOE currently maintains five high frequency relay station facilities around the country in support of its redundant secure communications network. KCP has maintained the high frequency relay station physically located south of KCP for nearly 20 years. Current responsibilities

include upkeep of the grounds including security fencing, mowing, building repair, generator repair, and maintenance of the computers, transmitters, receivers, and antenna field.

Electrical Components

Hybrid Microcircuit Substrates . Ceramic substrates with conductor patterns are needed to support assembly of circuits for radar units. These substrates would be purchased to meet the circuit layout specifications.

High Energy Density Capacitors and Passives: Ceramic Capacitors, Resistors, and Filters. This group of components includes high energy density capacitors and all passive electrical components such as capacitors, resistors, and filters.

Integrated Circuits and Semiconductor Components. These components include the full range of all the semiconductor products including diodes, transistors, and large-scale integrated circuits used in war reserve assemblies.

Joint Test Assembly Components. These are telemetry components used on joint test assemblies that are all procured from outside suppliers. They include pulse code modulators, voltage controlled oscillators, a mixer amplifier, a crystal oscillator, transmitters, and transponders.

Printed Wiring Products . This group of products consists of a wide variety of items processed in the printed wiring facility at KCP. These products range from rigid multilayer boards, multilayer flex, and special material boards to polyimide quartz boards, detonator cables, and chem-milled products used to fabricate rolamites.

Interconnects Cable Fabrication. Cable fabrication includes round wire, flat flex, and radio frequency types of cables.

Junction Boxes . Junction boxes are used to electrically connect internal weapons components to each other and the weapon control panel. The junction box has many lines and some components internally wired to several connectors at the junction box surface. The various weapon components are then attached with cables to the junction box connectors as the weapon is being assembled.

Mechanical Components

Transducers. Transducer components consist of pressure transducers, accelerometers, rate gyro assemblies, and temperature piezoelectric transduces.

Radio Frequency and Multicontact Connectors. The radio frequency multicontact connector product category includes all electrical connectors used on all weapons programs. The primary next-assemblies for the radio frequency and coaxial connectors are radars, antenna systems, and system-level coaxial cable assemblies. The multipin connectors are used throughout systems on firesets, radars, and programmers, in addition to being used for system-connect cables.

Handling Gear. Weapon systems require specially designed equipment for handling, lifting, and transportation called handling gear. There are two distinct types of handling gear: team gear and ultimate user package gear. Team gear is designed by SNL and is purchased by DOD. Ultimate user package gear is typically designed by SNL for DOE; thus, DOE owns and maintains it. Ultimate user

package gear normally consists of shipping and storage containers and bomb hand trucks.

Piezoelectric Motors . Miniature piezoelectric motors are currently being developed to replace solenoids in some applications.

Molded Plastic Parts . There are 550 to 650 molded plastic parts in weapon systems. Approximately 60 percent of the parts contain inserts that are molded in place. Most of the parts are transfer-molded, with some compression-molded and some injection-molded.

Major Mechanical Parts . Major mechanical parts are nonfunctional structural components. Most of these parts will be machined metal components, but they could also be components fabricated from plastics, ceramics, or sheet metal.

O-rings, Cushion, and Gaskets . O-rings are used extensively in maintaining environmental and functional seals in most nuclear weapons systems. There are many types of materials available to compensate for the effects of temperature changes and materials compatibility within the weapon system.

Honeycomb Parts . Honeycomb components are used for structural purposes and shock mitigation in some nuclear weapons systems.

Parachute Assemblies . Parachute assemblies consist of four major components: the parachute tube and end, the parachute, the reefing line cutter, and the explosive deployment component. The parachute tube is a machined component. In some systems, a pilot parachute and ejection plate are used in place of a tube.

Commercial Hardware . Commercial hardware encompasses all the small hardware items used to support weapon builds, limited-life component exchanges, and stockpile maintenance. This includes screws, bolts, nuts, and other fasteners, as well as other commercially available parts.

Precision Machining . Precision machining is a service required for numerous products currently manufactured at KCP. Various machining processes are already available at SNL that could be utilized in support of war reserve production activities. The local and national vendor base with precision machining capability has been well categorized in the past, and good relations with sufficient case histories are present to aid the transition from make in-house to buy outside.

Gas Transfer Systems-Buy Items . Because SNL plans to do only final assembly, testing, and acceptance of reservoirs, there would be significant procurement of piece parts and subassemblies. All electro-explosive valves and interconnect tubing and fittings would be procured from commercial suppliers. Similarly, all machined reservoir components from hemispheres, caps, stems, sleeves, and forgings would be machined by private industry. Currently, buy items such as nuts, bolts, washers, protective caps, and raw material for forgings will continue to be procured commercially.

Materials/Explosives/Other

Detonator Cables . Detonator cables (nonprimary) consist of a header that contains the electrical wire leads and the bridge wire. Header material may vary from plastic to a metal/ceramic combination. The electric connection may be hookup wire leads, coaxial, or multipin assembly.

Military Base Spare . Military base spares are kits that DOE is required to provide to the military to maintain nuclear weapons. Currently, about 140 different kits are supplied with approximately 50 percent of the items consisting of off-the-shelf hardware and 50 percent being limited-shelf-life chemicals.

Nuclear-Grade Materials . Nuclear-grade materials comprise special controlled chemistry wrought product (bar and plate stock) used for critical and noncritical applications. This encompasses special specification materials for gas transfer systems as well as commercial grade materials for structural and nonstructural applications.

The only products to be assembled or manufactured at SNL would be those that have exceptional security requirements or that employ technologies unavailable in the commercial sector. The principal activity at SNL would be the assembly of piece parts and subassemblies procured from the commercial sector, and manufacture and assembly of those components with special security requirements. Key nonnuclear product and program descriptions for items to be manufactured in-house are described in the following sections.

System Level

Arming, Fuzing, and Firing Assembly. This process is the final assembly of the arming, fuzing, and firing subsystems. This major hardware assembly is composed of printed wiring boards, battery pack, various electronic components, connectors, wiring harness, other materials, and outer containers. All are assembled in a precise step-by-step process to meet rigid final assembly requirements. The arming, fuzing, and firing assembly is a complex process involving many different activities, supporting equipment, and personnel skill sets to achieve product realization. It is not expected that the SNL assembly process would be markedly different from that employed at KCP.

Nose Assemblies . Nose assembly includes both new-build and refurbishment assemblies. The nose assembly process is straightforward and involves several different activities, supporting equipment, and personnel skill sets.

Joint Test Assemblies . Joint test assemblies consist mainly of internal power supplies, signal conditioning, circuitry, neutron and/or x-ray detectors, and analog and digital circuitry to process data during DOE test flights. This data is transmitted to ground stations or stored in an internal data recorder for recovery after the flight.

Safeguards Transporter . The safeguards transporter new-build activity integrates both new and proven security and safety technologies into a modern transport design that will ultimately replace the safe secure trailer. The safeguards transporter project includes developing a manufacturing capability and producing safeguards transporters. Approximately 20 percent of the production work would be done at SNL and 80 percent would be procured commercially.

Electrical Components

Lightning Arrester Connectors . Lightning arrester connectors are multicontact circular hermetic connectors that must reliably function as a connector in normal environments and must divert current from a direct lightning strike, or any other high voltage source, from the connector contacts to the connector shell. A lightning arrester connector is made from commercially manufactured connector

shell and piece parts, combined with specially formulated granules. The special granules give the lightning arrester connector its lightning protection capability.

Firesets Capacitor Discharge Unit Firing Systems. The primary purpose of a capacitor discharge unit firing system is to provide the timing and initiation power for the weapon electrical system. The firing systems also provide the packaging for other weapon components depending on the specific requirements. Hence, firing systems use low and high voltage circuits, power and voltage switches, stronglinks, regulators, and related circuitry. The processes currently in use at KCP would continue much the same at SNL except that more parts would be commercially procured.

Radars . The following list briefly outlines the required processes:

- Radio frequency and printed wiring assembly: kitting of parts, circuit board population, belt/hand soldering, cleaning, laser marking, final visual/electrical inspection
- Channel assembly: install logic/converter and radio frequency assemblies, attach flex, cables, clean, first visual/electrical inspection, temperature cycle, encapsulate, final visual/electrical inspection
- Radar assembly: select two channels, first electrical, install desiccant and compression pad, laser weld channels, first leak test, purge and backfill, weld evacuated tubes, final leak test, laser mark, final visual/electrical inspection
- E-test/D-test: short/medium term vibration, shock, temperature cycling, electrical test, dissection

Antennas . The process of antenna manufacturing consists of machining, welding, and plating a housing. Feed network component parts are assembled into the housing and welded together. A dielectric is sealed into the housing, and the assembly is leak tested. The completed assembly then undergoes an environmental preconditioning (temperature cycling). The antenna is then radio frequency tested on a ground plane in an anechoic chamber. Samples are pulled periodically and undergo test environments to ensure product and process reliability.

Use Control Hardware . All use control hardware would be manufactured in-house. In some cases, commercial parts would be used. All repair of use control hardware would also be performed in-house.

Mechanical Components

Gas Transfer Systems . Gas transfer systems include high pressure reservoirs for containing either boost or inert working gases, explosive valves to open the reservoirs, and tubulations and connectors to transfer the contained gases to required locations within the weapon. Electro-explosive valves are used to accomplish several functions including opening and closing gas flow paths and/or diverting gas flow. SNL currently possesses reservoir production capability but without sufficient capacity. The fabrication process begins with commercial vendor-supplied metal forgings made from certified controlled chemistry bar stock material procured by SNL. Piece parts and subassemblies would be qualified and certified at the vendor by SNL personnel. Final reservoir assembly, primarily welding, would be conducted at SNL along with final inspection and testing. The only machining done at SNL would be post-welding dressing to achieve final contours in the welded areas. Final certification, including volume measurement and proof testing, packaging, and shipping, would be an SNL responsibility.

Desiccants and Getters. Desiccants are made of molded materials that combine epoxies, curatives, and zeolite desiccant material. Getters are organic compounds that are mixed with a catalyst and binder. Getters and desiccants are used to control environments in weapon systems. SNL would use the current KCP processes.

Process Support Systems. Process support systems include capabilities and facilities that are used to support production activities across a wide variety of product lines. These range from general, commonly used services such as materials characterization, and analysis, and environmental and nondestructive testing, to more specialized support such as failure analysis and reliability physics for semiconductor devices, and metrology. While the general activity transfer philosophy is to purchase goods and services from commercial sources wherever possible, the approach with the services and support systems described here is to meet requirements by building upon SNL's existing capabilities. In almost all cases, these capabilities must be maintained in order to meet SNL traditional missions. In addition, particularly for analytical and testing services, the wide spectrum of required tests coupled with the large capital expenditure for testing instrumentation makes commercial availability of these services uncommon.

The alternative for siting nonnuclear production facilities in New Mexico at SNL calls for providing a new stand-alone production site. New production facilities would be provided near an existing Technical Area. Figure A.3.6.4-1 indicates location of technical areas at SNL. The new site (figure A.3.6.4-2) would be independent of the existing technical areas, 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 major 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. Table A.3.6.4-1 lists key facilities. A description of the key nonnuclear fabrication facilities is discussed in the following section.

Office and Distribution Center. Standard open-bay office setup with modular furniture, break areas, files and reproduction areas, conference rooms, secure storage, and executive offices. This space would also include a visitor entry way, an equipment room, and a communications room.

Distribution Center Facility. This would be a standard environmentally controlled warehouse with an administrative office section. Space would include an equipment and communications room.

Electronic Assembly Facility. This facility would include electronic assembly, clean room, and heavy lab capability. Its modules would contain clean rooms, screen room, conductive flooring, special temperature and humidity areas, and assembly areas. The space would include a chemical and materials handling and distribution area, an equipment room, and communications room.

Mechanical Assembly Facility. This facility would include a high bay, heavy lab, mechanical assembly, clean room, and some offices. It would also contain a precision machine shop with forges, presses, ovens, and other metal-forming and metal-treating equipment, mechanical assembly areas, and clean room areas. Space would include an equipment room and a communications room.

Table A.3.6.4-1.-- Sandia National Laboratories Nonnuclear Fabrication Facility Data

Facility	Floor Space (m^2)
Office facility	10,219
Distribution center facility	12,277
Electronics assembly facility	16,537
Mechanical assembly facility	6,225
Special production facility	5,574
Central utility building	929
Existing building modifications	5,110
Additional contingency space	4,645
Total	*61,316*

SNL 1995e.

Special Products Facility. The space would include a high bay, heavy lab, electrical assembly, mechanical assembly, clean room, equipment and communications room. This facility would also have a vault-type security system for controlled areas.

Central Utility Building . In addition to the central chiller and other utilities, this facility would serve as the maintenance headquarters for the site. It would contain offices, records storage, and an emergency management center.

Construction activities would consume electrical power, potable and construction water, and fuel for heavy construction equipment. Emissions generated during construction would include vehicle exhausts and fugitive dust from land clearing and other construction operations. Wastes generated during construction would consist of wash water, construction debris, scrap materials, and hazardous materials such as lead paint and asbestos collected during renovation of older buildings. A list of materials and resources consumed during construction can be found in table A.3.6.4-2.

The number of construction personnel can be found in table A.3.6.4-3.

Table A.3.6.4-2.-- Sandia National Laboratories Nonnuclear Fabrication Construction Materials/Resources Requirements

Material/Resource	Total Consumption	Peak Demand
Electricity	46.8 MWh	2.5 MWe
Fuel (L)	2,600,000	
Water (L)	2,200,000	
Concrete (m *3*)	12,800	
Steel (t)	5,440	
Industrial Gases	NA	
NA - not applicable. **SNL 1995b:5; SNL 1995e.**		

Table A.3.6.4-3.-- Sandia National Laboratories Nonnuclear Fabrication Construction Workers

	Personnel Required			
Employees	Year 1	Year 2	Year 3	Total

All crafts and laborers	120	320	200	640
Supervisors and foremen	10	23	16	49
Office and support	20	26	20	66
Inspectors	8	10	8	26
Total Employment	158	379	244	781
SNL 1995e.				

Utilities consumed during operation would include electric power; natural gas-fired and/or central-plant steam heat, potable, fire protection, irrigation, and process hot/chilled water; clean dry air; and sanitary sewer. The central steam plant is fired by commercially purchased natural gas. Electric power is purchased from the local utility, who generates it from coal-fired plants augmented by a natural-gas fired peak-power plant. Water is pumped electrically from wells. The other utilities are produced through the use of electrical power. The actual consumables used by SNL directly, therefore, are electricity, natural gas, and water. The surge operation utilities usages are listed in table A.3.6.4-4. A list of annual chemical use during operation can be found in table A.3.6.4-5.

Emissions from the complex during operations would include exhaust from vehicles and small quantities of aromatic hydrocarbon solvents, alcohols, and related chemistry. Usage quantities of these chemicals preclude any possibility of emissions greater than the *9.1* t (10 tons) per year threshold for *Clean Air Act* 1990 amendments. A list of these emissions can be found in table A.3.6.4-6.

Table A.3.6.4-4.-- Sandia National Laboratories Nonnuclear Fabrication Surge Operation Annual Utility Requirements

Utility	**Consumption**	**Peak Demand 23**
Electricity	39,700 MWh	6.2 MWe
Liquid fuel	0	
Natural gas 24 (m3)	*3,270,000*	
Raw water (L)	893,000,000	

Table A.3.6.4-5.-- Sandia National Laboratories Nonnuclear Fabrication Surge Operation Annual Chemical Requirements

Chemical	**Quantity**

Nitrogen	
Gas (m *3)*	3,270
Liquid (L)	14,900,000
Argon	
Gas (m *3*)	4,830
Liquid (L)	236,000
Carbon dioxide	
Gas (m *3)*	322
Liquid (L)	121,000
Hydrogen	
Gas (m *3)*	0.1

Helium	
Gas (m *3)*	883
Liquid (L)	1,650
SNL 1995b:4.	

Table A.3.6.4-6.-- Sandia National Laboratories Nonnuclear Fabrication Surge Operation Annual Emissions

Pollutant	Quantity (t)
Acetone	0.44
Carbon monoxide	13.17
Chromium	<0.01
Cyanide	0.01
Ethyl benzene	0.05
Formaldehyde	<0.01

Hydrochloric acid	0.03
Isopropyl alcohol	1.62
Methanol	0.01
Methyl ethyl ketone	0.16
Methyl isobutyl ketone	0.03
Particulate matter	1.03
Perc	0.29
Sulfur dioxide	0.35
Toluene	0.50
Toluene diisocyanate	<0.01
1,1,1-Trichloroethane	0.04

Trichloroethylene	2.60
Volatile organic compound	1.9
Xylene	0.26
SNL 1995b:4.	

Waste Management. The solid and liquid nonhazardous wastes generated during construction would consist of the collection and ponding of wash water,
landfilling of construction debris and scrap materials (especially from the renovation of existing buildings), and collection and disposal of hazardous materials (primarily asbestos and lead paint) during renovation of older buildings. The nonhazardous wastes generated during construction would be disposed of as part of the construction project by the contractor. Uncontaminated wastewater would be used for soil compaction and dust control, and excavated soil would be used for grading and site preparation. Wood, paper, and metal wastes would be shipped offsite to a commercial contractor for recycling. Hazardous wastes generated during construction would consist of such materials as waste adhesives, oils, cleaning fluids, solvents, and coatings. Hazardous waste would be packaged in DOT-approved containers and shipped offsite to commercial RCRA-permitted treatment, storage, and disposal facilities. No radioactive waste would be generated during construction.

The project design considers and incorporates waste minimization and pollution prevention. To facilitate waste minimization, where possible, nonhazardous materials would be substituted for those materials which contribute to the generation of hazardous waste. Production processes would be configured with minimization of waste production given high priority. Material from the waste streams would be treated to facilitate disposal as nonhazardous wastes, where possible. Future D&D considerations have also been incorporated into the design.

Table A.3.6.4-7 presents the estimated annual waste volumes from the Nonnuclear Fabrication Facility at SNL during construction and surge operations. Solid and liquid wastestreams are routed to the waste management system. Solid wastes would be characterized and segregated into hazardous or nonhazardous wastes, then treated to a form suitable for disposal or storage within the facility. Liquid wastes would be treated onsite to reduce hazardous/toxic elements before discharge or transport. All fire sprinkler water discharged in process areas is contained and treated as process wastewater, when required.

No new wastestreams would be generated. Wastes from the complex would include metal and dielectric material machining chips and turnings, solder scrap, acids and other eychants, curing compounds for various electrical encapsulants, test and analytical reagents, hydraulic fluid and other machine servicing compounds, reverse-osmosis backflush water, silicon slurries and other wastes generated as part of integrated circuit manufacture, sanitary sewer flows, and related materials.

Transuranic Waste. The Nonnuclear Fabrication Facility at SNL would not generate any TRU waste.

Low-Level Waste. The Nonnuclear Fabrication Facility at SNL would not generate any LLW.

Mixed Low-Level Waste. The Nonnuclear Fabrication Facility at SNL would not routinely generate any mixed LLW.

Hazardous Waste. Hazardous wastes generated by the Nonnuclear Fabrication Facility at SNL would consist of acids and other etchants, curing compounds, solvents, test and analytical reagents, and other wastes generated as part of integrated circuit manufacture. Liquid hazardous wastes would be collected in DOT-approved containers and sent to an onsite hazardous waste accumulation area. The hazardous waste accumulation area would provide a 90-day staging capacity prior to shipment to an offsite commercial RCRA-permitted treatment, storage, and disposal facility, using DOT-certified transporters. After compaction, if appropriate, the solid hazardous wastes would be packaged in DOT-approved containers and sent to a hazardous waste accumulation area for staging, characterization, and packaging prior to shipment to an offsite commercial RCRA-permitted treatment, storage, and disposal facility using DOT-certified transporters.

Nonhazardous (Sanitary) Waste. Nonhazardous liquid waste generated at the Nonnuclear Fabrication Facility primarily consists of reverse-osmosis backflush water, and sanitary sewer flows. Nonrecyclable, nonhazardous solid sanitary and industrial wastes would be compacted and disposed of in local commercial facilities. Liquid sanitary wastes would be collected by independent underground septic tanks at nonnuclear fabrication buildings and by sewer pipe systems from most of the support buildings and routed to municipal treatment facilities. Excess water is discharged to a natural drainage channel. Process wastewater is sent to holding tanks for pretreatment and screening prior to discharge to the publicly owned treatment works. The sewage wastewater would be routinely monitored for radioactive contaminants.

Nonhazardous (Other) Waste. Stormwater from areas of SNL is allowed to go in natural drainage channels.

Table A.3.6.4-7.-- Sandia National Laboratories Nonnuclear Fabrication Waste Volumes

Category	Annual Average Volume Generated from Construction (m *3*)	Annual Volume Generated from Surge Operations 25 (m *3*)	Annual Volume Effluent from Surge Operations (m *3*)
Low-Level 26			
Liquid	None	None	None
Solid	None	None	None
*Mixed Low-Level*26			
Liquid	None	None	None
Solid	None	None	None

Hazardous			
Liquid	0.11	15	15
Solid	23	17	17
Nonhazardous (Sanitary)			
Liquid	6,160 27	291,470	291,470 28
Solid	236	7,880	3,940 29
Nonhazardous (Other)			
Liquid	383 30	Included in sanitary	Included in sanitary
Solid	5	Included in sanitary	Included in sanitary

1

LLNL is an alternative site for production of nonnuclear plastic components.

KC ASI 1995a; LANL 1995c; LLNL 1995f; SNL 1995e.

2

Peak demand is the maximum rate expected during any hour.

3

Cubic meters measured at standard temperature and pressure.

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

4

LLW or mixed LLW would not be routinely generated during normal operations. 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.

5

Space in existing facility that will be used for the proposed production activity.

6

Includes mezzanines.

LANL 1995c.

7

Peak demand is the maximum rate expected at any hour.

LANL 1995b:3; LANL 1995c.

8

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

9

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

10

Assumes that 2/3 of the solid waste is compactible by a factor of 4:1.

11

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

12

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

13

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

LANL 1995c.

14

Peak demand is the maximum expected during any hour.

LLNL 1995f.

15

Peak demand is the maximum rates expected at any hour.

LLNL 1995f; LLNL 1995i:2

16

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

17

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.

18

Assumes toluene/methanol wastestream 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.

19

No data provided for liquid sanitary wastes such as sewage. Assumed 50 gal per day per person, 250 days per year operation. Number of employees used is 47.5. The urea waste stream was multiplied by 2.5. The rest of the sanitary waste was multiplied by 2.4 for three shifts.

20

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

21

No data provided for solid sanitary wastes such as housekeeping trash. Assumed 0.3 ft3 per day per person, 250 days per year operation. Number of employees used is 47.5, which was multiplied by 2.4 to get three shifts.

22

Assumes that 2/3 of the solid waste is compactible by a factor of 4:1.

LLNL 1995f; LLNL 1995i:2.

23

Peak demand is the maximum rate expected during any hour.

24

Cubic meters measured at standard temperature and pressure.

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

25

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

26

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

27

No data provided. Assumes 25 gallons per day per construction worker for 250 days per year and 260 construction workers. Construction toilets are trucked off site for servicing.

28

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

29

Assumes that 2/3 of the solid waste is compactible by a factor of 4:1.

30

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

SNL 1995b:5; SNL 1995e.

APPENDIX B: AIR QUALITY

B.1 Introduction

This appendix provides detailed data that support impact assessments for air quality addressed in sections 4.X.2.3, Affected Environment--Air Quality and 4.X.3.3, Environmental Impacts--Air Quality. The data presented include emission inventories from site-related activities and facility emissions for various alternatives. Section B.2 presents the methodology and models used in the air quality assessment. Section B.3 presents supporting data applicable to each site. The tables included in sections B.3.2 through B.3.9 contain site-specific information applicable to the air quality assessments at each site including figures containing wind rose data specific to each site.

B.2 Methodology and Models

The assessment of potential impacts to air quality is based upon comparisons of proposed project effects with applicable standards and guidelines. The Industrial Source Complex Short-Term model, version 2, is used to estimate concentrations of pollutants from emission sources at each site.

The air quality modeling analysis performed for the alternative sites is considered a "screening level" analysis incorporating conservative assumptions applied to each of the sites such that the impacts associated with the respective alternatives could be compared among the sites. The assumptions are as follows: major source criteria pollutant emissions were modeled using actual source locations and stack parameters to determine No Action criteria pollutant concentrations; toxic/hazardous pollutant emissions were modeled from a single source centrally located within the complex of facilities on each site assuming a 10-meter (m) (32.8-foot [ft]) stack height, a stack diameter of 0.3 m (1 ft), stack exit temperature equal to ambient temperature, and a stack exit velocity equal to 0.03 m/second (s) (0.1 ft/s), unless otherwise specified.

These assumptions will tend to overestimate pollutant concentrations since no credit is given to spacial and temporal variations of emission sources.

Emission sources for the facilities for each alternative were located at the same location as the existing toxic/hazardous pollutant emission sources and assumed the modeling parameters used for these emissions.

B.3 Supporting Data

B.3.1 Overview

This section presents supporting information for each of the eight existing Department of Energy (DOE) sites considered under various alternatives. Table B.3.1-1 presents the air quality standards applicable to each site. Subsequent sections present supporting information used in the air quality analysis at Oak Ridge Reservation (ORR), Savannah River Site (SRS), Kansas City Plant (KCP), Pantex Plant (Pantex), Los Alamos National Laboratory (LANL), Lawrence Livermore National Laboratory (LLNL) (which includes the Livermore Site and Site 300), Sandia National Laboratories (SNL), and Nevada Test Site (NTS).

Table B.3.1-1.-- Ambient Air Quality Standards Applicable to the Candidate Sites

Pollutant	Averaging Time	Primary NAAQS mg/m^3	Secondary NAAQS mg/m^3	California (Livermore Site and Site 300) mg/m^3	Nevada (NTS) mg/m^3	Kansas (KCP) mg/m^3	Texas (Pantex) mg/m^3	Tennessee (ORR) mg/m^3
Criteria Pollutant								
Carbon monoxide	Annual	2	2	2	2	2	2	2
	8-hour	10,000	2	10,000	10,000	10,000	10,000	10,000
	1-hour	40,000	2	23,000	40,000	40,000	40,000	40,000
Lead	Calendar quarter	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	30-day	2	2	1.5	2	2	2	2
Nitrogen dioxide	Annual	100	100	100	100	100	100	100
	24-hour	2	2	2	2	2	2	2
	1-hour	2	2	470	2	2	2	2
Ozone	1-hour	235	235	180	235	235	235	235
Particulate matter	Annual	50	50	30	50	50	50	50
	24-hour	150	150	50	150	150	150	150
Sulfur dioxide	Annual	80	2	80	80	80	80	80
	24-hour	365	2	105	365	365	365	365
	3-hour	2	1,300	1,300	1,300	1,300	1,300	1,300
	1-hour	2	2	655	2	2	2	2
	30-minute	2	2	2	2	2	1,045	2
State and County Mandated Pollutants								
Arsenic, Copper & Zinc	30-day	2	2	2	2	2	2	2

Beryllium	30-day	2	2	0.01	2	2	2	2
	24-hour	2	2	2	2	2	0.01	2
Hydrocarbons (non-methane)	3-hour	2	2	2	2	2	2	2
Hydrogen	30-day	2	2	2	2	2	0.8	1.2
fluoride	7-day	2	2	2	2	2	1.6	1.6
	24-hour	2	2	2	2	2	2.9	2.9
	12-hour	2	2	2	2	2	3.7	3.7
State and County Mandated Pollutants (Continued)								
Hydrogen sulfide	1-hour	2	2	42	112	2	2	2
30-minute	2	2	2	2	42	2	2	2
Photochemical oxidants	1-hour	2	2	2	2	2	2	2
Sulfate	24-hour	2	2	25	2	2	2	2
Sulfuric acid	24-hour	2	2	2	2	10	2	2
	1-hour	2	2	2	2	30	2	2
Total reduced sulfur	1-hour	2	2	2	2	2	2	2
Total	Annual	2	2	2	2	2	2	2
suspended	30-day	2	2	2	2	2	2	2
particulates	7-day	2	2	2	2	2	2	2
	24-hour	2	2	2	2	2	2	150
Vinyl chloride	24-hour	2	2	26	2	2	2	2

B.3.2 Oak Ridge Reservation

This section provides information on meteorology and climatology, emission rates, modeling assumptions, atmospheric dispersion characteristics, and annual mean wind speed and direction frequencies (figure B.3.2-1) at ORR. Table B.3.2-1 presents emission source inventories for criteria and toxic/hazardous pollutants at ORR. This information supports data presented in the

environmental impacts section for air quality.

Climatology and Meteorology. The wind direction above the ridge tops and within the valley at ORR tends to follow the orientation of the valley. On an annual basis, the prevailing winds at the National Weather Service station in the city of Oak Ridge are either up-valley, from west to southwest, or down valley, from east to northeast. Figure B.3.2-1 shows mean wind speeds and direction frequencies for 1990 measured at the 30-m (100-ft) level of the ORR meteorology tower. The prevailing wind directions are from the southwest and northeast quadrants. Annual mean wind speeds measured in the region are relatively low averaging 2 m/s (4.5 miles per hour [mph]) at the Oak Ridge National Weather Service station at the 14-m (46-ft) level and 2.1 m/s (4.7 mph) at the ORR Bethel Valley monitoring station at the 10-m (32.8-ft) level. The average annual temperature at ORR is 13.7 degrees Celsius (°C) (56.6 degrees Fahrenheit [°F]); temperatures vary from an average daily minimum of -3.8 °C (25.1 °F) in January to an average daily maximum of 30.4 °C (86.7 °F) in July. Relative humidity readings taken 4 times per day range from 51 percent in April to 92 percent in August and September (NOAA 1994c:3).

The average annual precipitation measured at ORR in Bethel Valley is 131 centimeters (cm) (56.1 inches [in]), while the average annual precipitation for the Oak Ridge National Weather Service station is 136.4 cm (53.77 in). The maximum monthly precipitation recorded at the Oak Ridge National Weather Service station was 48.9 cm (19.27 in) in July 1967, while the maximum rainfall in a 24-hour period observed was recorded in August 1960 at 19 cm (7.48 in). The average annual snowfall as measured at the Oak Ridge National Weather Service station is 24.9 cm (9.8 in) (NOAA 1994c:3).

Damaging winds are uncommon in the region. Peak gusts recorded in the area range from 26.8 to 30.8 m/s (60 to 69 mph) for the months of January through July; from 21.9 to 26.8 m/s (49 to 60 mph) for August, September, and December; and 16.1 to 20.1 m/s (36 to 45 mph) in October and November (ORNL 1982a:2-72). The fastest mile wind speed (the 1 mile [mi] [1.6 kilometer {km}]) passage of wind with the highest speed for the day) recorded at the Oak Ridge National Weather Service station for the period of record 1958 through 1979 was 26.4 m/s (59.1 mph) in January 1959 (NOAA 1994c:3).

The extreme mile wind speed at a height of 9.1 m (30 ft) that is predicted to occur near ORR once in 100 years is approximately 39.8 m/s (89 mph). The approximate values for occurrence intervals of 10, 25, and 50 years are 28.6, 32.6, and 34.0 m/s (64, 73, and 76 mph), respectively (ORNL 1981a:3.3-7).

Between 1916 and 1972, there were 25 tornadoes reported in the counties of Tennessee having borders within about 64.4 km (40 mi) of ORR. The probability of a tornado striking a particular point in the vicinity of ORR is estimated to be 3.6x10 *-4* per year (ORNL 1982a:2-125).

On February 21, 1993, a tornado passed through the northeastern edge of ORR and caused considerable damage to a number of structures in the nearby Union Valley Industrial Park. Damage from this tornado to ORR was relatively light. The wind speeds associated with this tornado ranged from 17.9 m/s (40.0 mph) to those approaching 58.1 m/s (130 mph) (OR DOE 1993c:iii).

Emission Rates. ORR exceeds the applicable 250-ton-per-year emissions criterion for nitrogen dioxide and sulfur dioxide and is therefore classified as an existing major source for these pollutants. The classification of ORR as a major source may require further prevention of significant

deterioration review than sites not classified as a major source. Table B.3.2-1 presents the emission rates for criteria and toxic/hazardous pollutants at ORR. These emission rates were used as input into the Industrial Source Complex Short-Term model, version 2, to estimate pollutant concentrations.

Modeling Assumptions. Additional model input used to estimate maximum pollutant concentrations at or beyond the ORR site boundary include the following: criteria pollutant emissions were modeled from actual stack locations using actual stack heights, stack diameter, exit velocity, and exit temperature, taken from operating permits; toxic/hazardous pollutant emissions were modeled from a centrally located stack in the Y-12 Plant (Y-12) complex at a height of 10 m (32.8 ft), stack diameter of 0.3 m (1.0 ft), exit velocity of 0.03 m/s (0.1 ft/s), and exit temperature equal to ambient temperature.

Table B.3.2-1.-- Emission Rates for Proposed Management Alternatives at Oak Ridge Reservation

Pollutant	2005 No Action (kg/yr)	Downsize Secondary and Case Fabrication (kg/yr) 3	Phaseout of Secondary and Case Fabrication (kg/yr)
Criteria Pollutant			
Carbon monoxide	95,000	89,500	(12,900)
Nitrogen dioxide	870,000	708,000	(357,000)
Particulate matter	8,300	7,930	(870)
Sulfur dioxide	972,000	904,000	(148,000)
Total suspended particulates	1,125,000	1,025,000	(110,000)
Hazardous and Other Toxic Compounds			
Acetic acid	1	1	(1)
Chlorine	1,750	1,740	(160)
Hydrogen chloride	6,420	5,480	(5,740)
Hydrogen fluoride	70	70	(70)

Hydrogen sulfide	4	4	4
Methyl alcohol	26,400	16,600	(23,800)
Nitric acid	9,500	8,100	(8,500)
Sulfuric acid	2,500	2,120	(2,180)
1, 1, 1-Trichloroethane	220	220	(200)

Atmospheric Dispersion Characteristics. Data collected at the ORR meteorological monitoring station (Y-12 east tower) for calendar year 1990 indicate that unstable conditions occur approximately 23 percent of the time, neutral conditions approximately 31 percent of the time, and stable conditions approximately 46 percent of the time, on an annual basis.

Annual Mean Wind Speeds and Direction Frequencies. ORR meteorological data for annual mean wind speed and direction for 1990 is presented in figure B.3.2-1 as a wind rose. As shown in this figure, the maximum wind direction frequency is from the east-northeast with a secondary maximum from the northeast. The mean wind speed from the east-northeast is 1.7 m/s (3.8 mph); from the northeast is 2.3 m/s (5.1 mph); while the maximum mean wind speed is 3.3 m/s (7.4 mph) from the southwest.

B.3.3 Savannah River Site

This section provides information on climatology and meteorology, modeling assumptions, atmospheric dispersion characteristics, and annual mean wind speed and direction frequencies (figure B.3.3-1) at SRS. Table B.3.3-1 presents emission source inventories for criteria and toxic/hazardous pollutants at SRS. This information supports data presented in the environmental impacts section for air quality.

Climatology and Meteorology. Figure B.3.3-1 shows annual mean wind speeds and wind direction frequencies for 1991 measured at the 60-m (200-ft) level of the SRS H-Area weather station. The wind data from the site indicate that there is no prevailing wind direction at SRS. The highest directional frequency is from the northeast. The average annual wind speed measured is 3.8 m/s (8.4 mph) (WSRC 1992h).

Table B.3.3-1.-- Emission Rates for Proposed Management Alternatives at Savannah River Site

Pollutant	2005 No Action (kg/yr)	Pit Fabrication (kg/yr)

Criteria Pollutant			
Carbon monoxide	404,449		685
Hydrogen fluoride	16,690		7
Nitrogen dioxide	4,278,380		15,666
Particulate matter	1,963,180		968
Sulfur dioxide	9,454,199		32,552
Total suspended particulates	4,430,890		5
Hazardous and Other Toxic Compounds	Point and Volume Source (kg/yr)	Area Source (kg/yr/m2)	
Acrolein	5	1.94×10^{-3}	5
Benzene	129,772.3	0.21	5
Bis (chloromethyl) ether	211.0	5	5
Cadium oxide	243.0	5	5
Chlorine	21,146.7	10.11	5
Chloroform	1,035,006	13.6	5
Cobalt	5,970.2	4.58×10^{-4}	5
3, 3-Dichlorobenzidine	211.0	5	5
Formic acid	46,949.5	5	5
Manganese	27,882.1	2.61	5
Mercury	917.5	1.15×10^{-3}	5
Nickel	23,022.5	6.02	5

Nitric acid	1,150,525.8	5	5
Parathion	6	6	5
Phosphoric acid	14,859.8	5	5

The average annual temperature at SRS is 17.3 °C (63.2 °F); temperatures vary from an average daily minimum of 0.0 °C (32 °F) in January to an average daily maximum of 33.2 °C (91.7 °F) in July. Relative humidity readings taken 4 times per day range from 45 percent in April to 92 percent in August and September (NOAA 1994c:3).

The average annual precipitation at SRS is 113.4 cm (44.66 in). Precipitation is distributed fairly evenly throughout the year, with the highest precipitation in summer, 32.7 cm (12.87 in) and the lowest in autumn, 21.2 cm (8.34 in). Although snow can fall from November through April, the average annual snowfall is only 2.8 cm (1.1 in); large snowfalls are rare (NOAA 1994c:3).

Winter storms in the SRS area occasionally bring strong and gusty surface winds with speeds as high as 22.8 m/s (51 mph). Thunderstorms can generate winds with speeds as high as 21.5 m/s (48.1 mph) and even stronger gusts. The fastest 1-minute wind speed recorded at Augusta between 1952 and 1993 was 27.7 m/s (62 mph) (NOAA 1994c:3).

The average number of thunderstorm days per year at SRS is 56. From 1954 to 1983, 37 tornadoes were reported for a 1-degree square of latitude and longitude that includes SRS. This frequency of occurrence amounts to an average of about one tornado per year. The estimated probability of a tornado striking a point at SRS is 7.1x10 -5 per year. Since operations began at SRS in 1953, nine tornadoes have been confirmed on or near SRS. Nothing more than light damage was reported in any of these storms, with the exception of a tornado in October 1989. That tornado caused considerable damage to timber resources in an undeveloped wooded area of SRS (WSRC 1990b:1).

From 1899 to 1980, 13 hurricanes occurred in Georgia and South Carolina, for an average frequency of about 1 hurricane every 6 years. Three hurricanes were classified as major. Because SRS is about 160 km (99.4 mi) inland, the winds associated with hurricanes have usually diminished below hurricane force (greater than or equal to a sustained speed of 33.5 m/s (75 mph) before reaching the site (DOE 1992e:4-115).

Emission Rates. SRS exceeds the applicable 250-ton-per-year emissions criterion for carbon monoxide, nitrogen dioxide, PM10, and sulfur dioxide and is therefore classified as an existing major source for these pollutants. The classification of SRS as a major source may require further prevention of significant deterioration review than sites not classified as a major source. Table B.3.3-1 presents the emission rates for criteria and toxic/hazardous pollutants at SRS. The toxic/hazardous pollutant emissions presented in the table represent those pollutants with estimated concentrations at or beyond the SRS boundary that exceed 1 percent of the state air quality standards. These emission rates were used as input into the Industrial Source Complex Short-Term model, version 2, to estimate pollutant concentrations.

Modeling Assumptions. Emission rates for criteria and toxic/hazardous pollutants were based upon site actual emissions data for the year 1990. Additional model input used to estimate maximum

criteria and toxic/hazardous pollutant concentrations at or beyond the SRS site boundary include pollutant emissions modeled from actual stack heights, actual effective stack diameters, actual exit velocity, and actual exit temperature.

Atmospheric Dispersion Characteristics. Data collected at the SRS meteorological monitoring station for 1991 indicate that unstable conditions occur approximately 38 percent of the time, neutral conditions approximately 43 percent of the time, and stable conditions approximately 19 percent of the time, on an annual basis.

Annual Mean Wind Speeds and Direction Frequencies. The SRS meteorological data for annual mean wind speed and direction for 1991 is presented in figure B.3.3-1 as a wind rose. As shown in this figure, the maximum wind direction frequency is from the northeast with a secondary maximum from the east-northeast. The mean wind speed from the northeast is 3.8 m/s (8.5 mph); from the east-northeast, 3.8 m/s (8.5 mph); while the maximum mean wind speed is 4.1 m/s (9.2 mph) from the west-northwest.

B.3.4 Kansas City Plant

This section provides information on meteorology and climatology, emission rates, modeling assumptions, atmospheric dispersion characteristics, and annual mean wind speed and direction frequencies (figure B.3.4-1) at KCP. Table B.3.4-1 presents emission source inventories for criteria and toxic/hazardous pollutants at KCP. This information supports data presented in the environmental impacts section for air quality.

Climatology and Meteorology. Figure B.3.4-1 shows annual mean wind speeds and wind direction frequencies for 1991 measured at the 10-m (32.8-ft) level of the Kansas City, Missouri National Weather Service station. The wind data from the Kansas City National Weather Service station indicate that the predominant wind direction frequency is from the south. The average annual wind speed measured is 4.8 m/s (10.8 mph). Average monthly wind speeds range from 5.6 m/s (12.6 mph) in March, to 4.1 m/s (9.1 mph) in August.

The average annual temperature at KCP is 12.0 °C (53.6 °F); temperatures vary from an average daily minimum of -8.5 °C (16.7 °F) in January to a daily mean maximum of 31.5 °C (88.7 °F) in July. Relative humidity readings taken four times per day range from 53 percent in April to 86 percent in August and September (NOAA 1994a:3).

The average annual precipitation at KCP is 95.6 cm (37.62 in). The highest precipitation occurs in the summer months, May through September, and the lowest in winter. Snow can fall from November through April, with the average annual snowfall being 51.1 cm (20.1 in) (NOAA 1994a:3).

Winter storms in the KCP area occasionally bring strong and gusty surface winds with speeds as high as 25.9 m/s (58 mph). Thunderstorms can generate winds with speeds as high as 33.5 m/s (75 mph) and even stronger gusts. The fastest 1-minute wind speed recorded at Kansas City National Weather Service station was 21.5 m/s (48 mph) (NOAA 1994a:3).

The average number of thunderstorm days per year at KCP is 51.8. The estimated probability of a tornado striking a point at KCP is 7.5x10 *-4* per year (NRC 1986a:32).

Emission Rates. Table B.3.4-1 presents the emission rates for criteria and toxic/hazardous pollutants

at the KCP. These emission rates were used as input into the Industrial Source Complex Short-Term model, version 2, to estimate pollutant concentrations.

Modeling Assumptions. Additional model input used to estimate maximum pollutant concentrations at or beyond the KCP site boundary include the following: criteria pollutant emissions were modeled from actual stack locations using actual stack heights, stack diameter, exit velocity, and exit temperature, taken from operating permits; toxic/hazardous pollutant emissions were modeled from a centrally located stack in the KCP complex at a height of 10 m (32.8 ft), stack diameter of 0.3 m (1.0 ft), exit velocity of 0.03 m/s (0.1 ft/s), and exit temperature equal to ambient temperature.

Table B.3.4-1.-- Emission Rates for Proposed Management Alternatives at Kansas City Plant

Pollutant	2005 No Action (kg/yr)	Downsize Nonnuclear Fabrication (kg/yr)	Phaseout of Nonnuclear Fabrication (kg/yr)
Criteria Pollutant			
Carbon monoxide	11,948	11,948	(11,948)
Nitrogen dioxide	42,574	42,574	(42,574)
Particulate matter	934	934	(934)
Sulfur dioxide	318	318	(318)
Total suspended particulates	934	934	(934)
Hazardous and Other Toxic Compounds			
Acetone	399	416	(399)
Chromium	<9	<9	(<9)
Cyanide	10.21	5.22	(10.21)
Ethyl benzene	45.4	45.4	(45.4)
Formaldehyde	<9	<9	(<9)

Hydrogen chloride	27.2	14.5	(27.2)
Isopropyl alcohol	1,470	2,538	(1,470)
Methanol	9	9	(9)
Methyl ethyl ketone	145	123.6	(145)
Methyl isobutyl ketone	27.2	27.2	(27.2)
Perchloroethylene	263	263	(363)
Toluene	454	506	(454)
Toluene-2,4-Diisocyanate	<9	<9	(<9)
Trichloroethane	36.3	36.3	(36.3)
Trichloroethylene	2,359	3,201	(2,359)
Xylene	235.9	235.9	(235.9)
Parentheses indicate a net reduction in emissions. **KC ASI 1995a.**			

Atmospheric Dispersion Characteristics. Data collected at the Kansas City National Weather Service station for calendar year 1991 indicate that unstable conditions occur approximately 15 percent of the time, neutral conditions approximately 61 percent of the time, and stable conditions approximately 24 percent of the time, on an annual basis.

Annual Mean Wind Speeds and Direction Frequencies. The Kansas City National Weather Service meteorological data for annual mean wind speed and direction for 1991 is presented in figure B.3.4-1 as a wind rose. As shown in this figure, the maximum wind direction frequency is from the south with a secondary maximum from the south-southwest. The mean wind speed from the south is 6.1 m/s (13.6 mph); while the maximum mean wind speed is 6.3 m/s (14.1 mph) from the south-southwest.

B.3.5 Pantex Plant

This section provides information on climatology and meteorology, atmospheric dispersion characteristics, and annual mean wind speed and direction frequencies (figure B.3.5-1) at Pantex. Table B.3.5-1 presents emission source inventories for criteria and toxic/hazardous pollutants at

Pantex. This information supports data presented in the environmental impacts section for air quality.

Climatology and Meteorology. Figure B.3.5-1 shows annual mean wind speeds and wind direction frequencies for 1991 measured at the 6.6-m (21.6-ft) level of the Amarillo National Weather Service station. Prevailing wind directions are from the south to southwest. The average annual wind speed measured is 6 m/s (13.5 mph).

The average annual temperature at Pantex is 13.8 °C (56.9 °F); average daily temperatures vary from a daily mean minimum of -5.7 °C (21.8 °F) in January to a daily mean maximum of 32.8 °C (91.1 °F) in July and August. Relative humidity readings taken four times per day range from 31 percent in April to 80 percent in September (NOAA 1994c:3).

The average annual precipitation at Pantex is 49.7 cm (19.56 in). Most of the annual precipitation falls during the months of April through October and usually occurs from thunderstorm activity and the intrusion of warm, moist tropical air from the Gulf of Mexico. Snowfall averages nearly 43 cm (16.9 in). Snowfall can occur from October through April. The maximum 24-hour rainfall with a 100-year recurrence interval is approximately 16.5 cm (6.5 in). On average, the area can expect thunderstorms about 50 days per year, hail 4 days per year, and freezing rain 8 days per year (NOAA 1994c:3). During the 30-year period between 1954 and 1983, a total of 108 tornadoes were reported within a 1-degree latitude and longitude square area which includes Pantex. On average, less than four tornadoes per year occur in an area of 10,096 km *2* (3,898 mi *2*) surrounding Pantex. The estimated probability of a tornado striking a point at Pantex is 2.3x10 *-4* per year (NRC 1986a:32).

Emission Rates. Table B.3.5-1 presents the emission rates for criteria and toxic/hazardous pollutants at Pantex. These emission rates were used as input into the Industrial Source Complex Short-Term model, version 2, to estimate pollutant concentrations.

Table B.3.5-1.-- Emission Rates for Proposed Management Alternatives at Pantex Plant

Pollutant	2005 No Action (kg/yr)	Downsize Assembly/ Disassembly and High Explosives (kg/yr)	Downsize Assembly/ Disassembly (kg/yr)	Phaseout of Assembly/ Disassembly and High Explosives (kg/yr)
Criteria Pollutant				
Carbon monoxide	22,493	5,856	5,443	(22,493)
Hydrogen fluoride	1,176.06	4.5	Z	(1,176.06)
Lead	185	Z	Z	(185)
Nitrogen dioxide	54,056	22,879	21,319	(54,056)

Particulate matter	8,439	884	816	(8,439)
Sulfur dioxide	0.1	0.03	0.02	(0.1)
Hazardous and Other Toxic Compounds				
Acetonitrile	Z	2.8	2.3	Z
Alcohols	1,184	Z	Z	(1,184)
Aldehydes	Z	6.5	4.5	Z
Ammonia	*<0.45*	*<0.45*	*<0.45*	*(<0.45)*
Benzene	91.38	3.0	Z	(91.38)
Carbon disulfide	27.05	Z	Z	(27.05)
Carbon tetrachloride	15.59	Z	Z	(15.59)
Chlorobenzene	1.79	Z	Z	(1.79)
1,1,1-Chloroethane	22.74	Z	Z	(22.74)
Chromium	2.14	Z	Z	(2.14)
Cyclohexane	Z	2.2	0.45	Z
Cresol	0.05	Z	Z	(0.05)
Cresylic acid	0.05	Z	Z	(0.05)
Dibensofuran	0.07	Z	Z	(0.07)
Dibutyl phthalate	Z	5.4	5.4	Z
Ester glycol ethers	0.86	Z	Z	(0.86)
Ethyl benzene	1.51	Z	Z	(1.51)

Ethylene dichloride	1.33	Z	Z	(1.33)
Formaldehyde	57.89	Z	Z	(57.89)
Hydrogen chloride	1,106.11	27.7	24.5	(1,106.11)
Hydrogen sulfide	*0*	21.3	21.3	*(0)*
Ketones	0.28	Z	Z	(0.28)
Mercury	*<0.45*	*<0.45*	*<0.45*	*(<0.45)*
Methanol	1,095.57	11.8	9.1	(1,095.57)
Methyl ethyl ketone	7,067.62	666.8	317.5	(7,067.62)
Methyl isobutyl ketone	0.62	Z	Z	(0.62)
Methylene chloride	182.07	Z	Z	(182.07)
Naphthalene	0.41	Z	Z	(0.41)
Nickel	0.16	Z	Z	(0.16)
Nitrobenzene	0.05	Z	Z	(0.05)
2-Nitropropane	1.71	Z	Z	(1.71)
Phenol	2.23	Z	Z	(2.23)
Propylglycol methyl ether	Z	7.3	7.3	Z
Hazardous and Other Toxic Compounds (Continued)				
Tetrachloroethylene	6.44	Z	Z	(6.44)
Toluene	465.29	14.0	4.5	(465.29)
1,1,1-Trichloroethane	Z	45.0	44.5	Z

1,1,2-Trichloroethane	3.78	7	7	(3.78)
Trichloroethene	1.56	7	7	(1.56)
Trichloroethylene	19.50	5.0	4.5	(19.50)
Triethylamine	0	7	7	(0)
Xylene	222.15	166.5	158.8	(222.15)

Atmospheric Dispersion Characteristics. Data collected at the Amarillo National Weather Service station for 1991 indicate that unstable conditions occur approximately 14 percent of the time, neutral conditions approximately 64 percent of the time, and stable conditions approximately 22 percent of the time, on an annual basis.

Annual Mean Wind Speeds and Direction Frequencies. The Amarillo meteorological data for annual mean wind speed and direction for 1991 are presented in figure B.3.5-1 as a wind rose. As shown in this figure, the maximum wind direction frequency is from the south with a secondary maximum from the south-southwest. The mean wind speed from the south is 6.3 m/s (14.1 mph); from the south-southwest is 6.3 m/s (14.1 mph); while the maximum mean wind speed is 6.6 m/s (14.8 mph) from the west.

B.3.6 Los Alamos National Laboratory

This section provides information on climatology and meteorology, modeling assumptions, atmospheric dispersion characteristics, and annual mean wind speed and direction frequencies (figure B.3.6-1) at LANL. Table B.3.6-1 presents emission source inventories for criteria and toxic/hazardous pollutants at LANL. This information supports data presented in the environmental impacts section for air quality.

Climatology and Meteorology. Figure B.3.6-1 shows annual mean wind speed and wind direction frequencies for 1991 measured at the 11.5-m (37-ft) level of the Technical Area (TA)-6 meteorological tower. Prevailing wind directions are from the south through northwest. The average annual wind speed measured is 2.8 m/s (6.3 mph) (LANL 1995s:II-11).

The average annual temperature at LANL is 8.8 °C (47.8 °F). In July, the average daily high temperature is 27.2 °C (81 °F), and the average nighttime low temperature is 12.8 °C (55 °F). The highest recorded temperature is 35 °C (95 °F). The average daily January high is 4.4 °C (40 °F), and the average nighttime low is -8.3 °C (17 °F). The lowest recorded temperature is -27.8 °C (-18 °F). The average monthly values of the dew point temperature range from -9.4 °C (15.0 °F) in January to 8.9 °C (48 °F) in August, when moist subtropical air invades the region. Fog is rare in Los Alamos, occurring on fewer than 5 days per year (LANL 1995s:II-11).

The average annual precipitation at LANL is 47.6 cm (18.7 in). Most of the annual precipitation falls during the months of July and August and usually occurs from convective storms. Snowfall averages nearly 150 cm (59 in). The maximum 24-hour rainfall is approximately 8.8 cm (3.5 in) (LANL

1995s:II-11).

The average annual temperature at the National Weather Service station at Albuquerque, NM, is 13.4 °C (56.2 °F); temperatures vary from an average daily minimum of -5.7 °C (21.7 °F) in January to an average daily maximum of 33.6 °C (92.5 °F) in July. Relative humidity readings taken four times per day range from 19 percent in April and May to 71 percent in January (NOAA 1994c:3).

The average annual precipitation is 22.6 cm (8.88 in). The maximum monthly precipitation recorded was 8.5 cm (3.33 in) in July 1968, while the maximum rainfall in a 24-hour period observed was recorded in September 1955 at 4.9 cm (1.92 in). The average annual snowfall is 28.2 cm (11.1 in); all measurements are from the Albuquerque National Weather Service station (NOAA 1994c:3). The average number of thunderstorm days per year is 58, with most occurring during the summer. The estimated probability of a tornado striking a point at LANL is 2x10 -5 per year (NRC 1986a:32). Historically, no tornadoes have been reported to have touched down in Los Alamos County (LANL 1993b:II-9).

Emission Rates. Table B.3.6-1 presents the emission rates for criteria and toxic/hazardous pollutants at LANL. These emission rates were used as input into the Industrial Source Complex Short-Term model, version 2, to estimate pollutant concentrations.

Modeling Assumptions. Additional model input used to estimate maximum pollutant concentrations at or beyond the LANL site boundary include the following: criteria pollutant emissions were modeled from actual stack locations using actual stack heights, stack diameter, exit velocity, and exit temperature, taken from operating permits; toxic/hazardous pollutant emissions were modeled from a centrally located stack in the LANL facility at a height of 10 m (32.8 ft), stack diameter of 0.3 m (1 ft), exit velocity of 0.03 m/s (0.1 ft/s), and exit temperature equal to ambient temperature.

Table B.3.6-1.-- Emission Rates for Proposed Stewardship and Management Alternatives at Los Alamos National Laboratory

Pollutant	2005 No Action (kg/yr)	Pit Fabrication (kg/yr)	Secondary and Case Fabrication (kg/yr)	High Explosives Fabrication (kg/yr)	Nonnuclear Fabrication (kg/yr)	Atlas Facility (kg/yr)	National Ignition Facility (kg/yr)
Criteria Pollutant							
Carbon monoxide	21,583	7	4,500	4,536	8	7	460
Lead	26	7	100	7	7	*<0.1*	7
Nitrogen dioxide	55,314	7	117,000	22,680	7	7	1,910
Particulate matter	2,983	7	300	227	7	7	180

Sulfur dioxide	704.6	7	48,000	7	7	7	30
Total suspended particulates 9	2,983	7	300	227	7	7	180
Hazardous and Other Toxic Compounds							
Acetic acid	537	7	7	7	7	7	7
Ammonia	799	7	7	454	7	7	7
2-Butoxyethanol	123	7	7	7	7	7	7
Chlorine	13	340	7	7	7	7	7
Chloroform	533	7	7	7	7	7	7
Ethyl acetate	89	7	7	7	7	7	7
Ethylene glycol	72	7	7	7	7	7	7
Formaldehyde	49	7	7	7	7	7	7
Heavy metals	114	7	7	7	7	7	7
Heptane (n-heptane)	1,849	7	7	7	7	7	7
Hexane (n-hexane)	77	7	7	7	7	7	7
Hydrogen chloride	638	*11*	7	113	7	7	7
Hydrogen fluoride (as F)	242	7	7	45.4	7	7	7
Isopropyl alcohol	539	7	7	7	7	*<0.1*	7
Kerosene	260	7	7	7	7	7	7

Methyl alcohol	589	Z	Z	Z	Z	Z	Z
Methyl ethyl ketone	1,864	Z	Z	22.7	Z	Z	Z
Methylene chloride	1,104	a	Z	Z	Z	Z	Z
Nickel	55	Z	Z	Z	Z	Z	Z
Nitric acid	661	Z	Z	Z	Z	Z	Z
Nitrogen oxide	428	Z	Z	Z	Z	Z	Z
Nonmethane hydrocarbons	2,893	Z	Z	Z	Z	Z	Z
Propane sultone	205	Z	Z	Z	Z	Z	Z
Stoddard solvent	264	Z	Z	Z	Z	Z	Z
Toluene	2,483	Z	Z	22.7	Z	Z	Z
1, 1, 2-Trichloroethane	927	Z	Z	Z	Z	*<0.1*	Z
Hazardous and Other Toxic Compounds (Continued)							
Trichloroethylene	210	Z	Z	Z	Z	*<0.1*	Z
Tungsten (as W) (insoluble)	109	Z	Z	Z	Z	Z	Z
VM&P naptha	613	Z	Z	Z	Z	Z	Z
Welding fumes	511	Z	Z	Z	Z	Z	Z
Xylene (o-, m-, p-isomers)	1,762	Z	Z	Z	Z	Z	Z

Atmospheric Dispersion Characteristics. Data collected at the TA-6 meteorological tower for 1991 indicate that unstable conditions occur approximately 45 percent of the time, neutral conditions approximately 21 percent of the time, and stable conditions approximately 34 percent of the time, on an annual basis.

Annual Mean Wind Speeds and Direction Frequencies. The TA-6 meteorological data for wind speed and direction for 1991 is presented in figure B.3.6-1 as a wind rose. As shown in this figure, the maximum wind direction frequency is from the west-northwest with a secondary maximum from the west. The mean wind speed from the west-northwest is 3.2 m/s (7.2 mph), which is also the maximum mean wind speed. The mean wind speed from the west is 3 m/s (6.7 mph).

B.3.7 Lawrence Livermore National Laboratory

This section provides information on climatology and meteorology, modeling assumptions, atmospheric dispersion characteristics, and annual mean wind speeds and direction frequencies (figures B.3.7-1 and B.3.7-2) at the Livermore Site and Site 300. Table B.3.7-1 presents emission source inventories for criteria and toxic/hazardous pollutants at the Livermore Site and Site 300. This information supports data presented in the environmental impacts section for air quality.

Climatology and Meteorology. Figures B.3.7-1 and B.3.7-2 show annual mean wind speed and wind direction frequencies for 1991 measured at the 10-m (32.8-ft) level of the Livermore Site and Site 300 meteorological monitoring sites. Prevailing wind directions at the Livermore Site are from the south-southwest through west while at Site 300 the prevailing wind direction is from the west-southwest. The average annual wind speed measured at the Livermore Site is 2.5 m/s (5.7 mph) while at Site 300 the average annual wind speed is 5.9 m/s (13.1 mph).

The annual mean temperature at the Livermore Site is 12.5 °C (54.5 °F); temperatures range from a minimum of 0 °C (32 °F) in the winter to 38 °C (100.4 °F) in summer (LLNL 1993b:1-2).

The average annual precipitation at the Stockton, CA National Weather Service station is 35.4 cm (13.95 in). Most of the annual precipitation falls from October through April. Snowfall is rare in the Livermore Site area. The maximum 24-hour rainfall is approximately 7.65 cm (3.01 in). On the average, the area can expect thunderstorms about 3.1 days per year (NOAA 1994d:3).

The climate at Site 300, while generally 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, and topography significantly influences surface wind patterns (LLNL 1993b:1-3).

Emission Rates. Table B.3.7-1 presents the emission rates for criteria and toxic/hazardous pollutants at the Livermore Site and Site 300. These emission rates were used as input into the Industrial Source Complex Short-Term model, version 2, to estimate pollutant concentrations.

Modeling Assumptions. Additional model input used to estimate maximum pollutant concentrations at or beyond the site boundary include the following: criteria pollutant emissions were modeled from actual stack locations using actual stack heights, stack diameter, exit velocity, and exit temperature, taken from operating permits; toxic/hazardous pollutant emissions were modeled from a centrally located stack in the facility at a height of 10 m (32.8 ft), stack diameter of 0.3 m (1.0 ft), exit velocity of 0.03 m/s (0.1 ft/s), and exit temperature equal to ambient temperature.

Table B.3.7-1.-- Emission Rates for Proposed Stewardship and Management Alternatives at the Site and Site 300

	2005 No Action					
Pollutant	**Livermore Site (kg/yr)**	**Site 300 (kg/yr)**	**Secondary and Case Fabrication (kg/yr)**	**High Explosives Fabrication (kg/yr)**	**NonnuclearFabrication (kg/yr)**	**Contai Firin Facili (kg/yr)**
Criteria Pollutant						
Beryllium	0.002	0.279	*12*	*12*	11	-
Carbon monoxide	5,629	1,854	1000	113.4	*11*	-
Lead	0.0068	0.059	*12*	*12*	*11/EM>*	-
Nitrogen dioxide	32,450	8,576	1,900	249.5	11	-
Particulate matter 13	4,636	993	100	22.7	11	-
Sulfur dioxide	430	99	20	*13.6*	11	-
Total suspended particulates	4,636	993	3,200	*22.7*	11	-
Hazardous and Other Toxic Compounds						
Acetone	818.7	45.4	12	12	11	-
Benzene	100.2	0.082	12	12	11	-
2-Butoxyethanol	153.8	12	12	12	11	-
Carbon tetrachloride	204.6	12	12	12	11	-
Chlorine	12	12	50	12	11	-

Chlorofluorocarbons	8,705.3	163.7	12	12	11	-
Chloroform	188.7	0.054	12	12	11	-
Ethanol	322.1	<0.45	12	12	11	-
Formaldehyde	53.52	1.91	12	12	11	-
Gasoline	12	367.1	12	12	11	-
Glycol ethers (other)	2.99	53.1	12	12	11	-
Hexane	59.4		12	12	11	-
Hydrogen chloride	64.4	60.2	1,600	*45.4*	11	-
Hydrogen fluoride	12	12	12	90.7	11	-
Hydrogen sulfide	12	12	12	12	11	-
Isopropyl alcohol	729.4	0.14	12	12	11	-
Methanol	949.37	12	4,500	12	11	-
Methyl ethyl ketone	338.4	0.27	12	6.8	11	-
Methylene chloride	133.81	1.72	12	12	11	-
Nephthalene	73.48	12	12	12	11	-
Nitric acid	12	12	2,300	12	11	-
Styrene	1,270.1	12	12	12	11	-
Sulfuric acid	12	12	600	12	11	-
Tetrohydrofuran	61.23	12	12	12	11	-
Toluene	384.65	18.44	12	12	11	-

1, 1, 1-Trichloroethane	981.6	12	12	12	11	-
Trichloroethylene	175.99	3.63	12	12	11	-
Xylene	222.26	4.99	12	2.7	11	-

Atmospheric Dispersion Characteristics. Data collected at the Livermore Site and Site 300 for 1991 indicate that unstable conditions occur approximately 32/37 percent of the time, neutral conditions approximately 35/34 percent of the time, and stable conditions approximately 33/29 percent of the time, on an annual basis.

Annual Mean Wind Speeds and Direction Frequencies. The 1991 meteorological data for wind speed and direction for the Livermore Site and Site 300 are presented in figures B.3.7-1 and B.3.7-2 as wind roses. As shown in the figures, the maximum wind direction frequency at the Livermore Site and Site 300 is from the southwest/west-southwest with a secondary maximum from the west-southwest/north-northwest. The mean wind speed from the southwest/west-southwest is 3.4/8.9 m/s (7.7/19.9 mph) and from the west-southwest/north-northwest is 3.0/6.3 m/s (6.7/14.1 mph).

B.3.8 Sandia National Laboratories

This section provides information on climatology and meteorology, modeling assumptions, atmospheric dispersion characteristics, and annual mean wind speeds and direction frequencies (figure B.3.8-1) at SNL. Table B.3.8-1 presents emission source inventories for criteria and toxic/hazardous pollutants at SNL. This information supports data presented in the environmental impacts section for air quality.

Climatology and Meteorology. Figure B.3.8-1 shows annual mean wind speeds and wind direction frequencies for 1991 measured at the 10-m (32.8-ft) level of the Albuquerque National Weather Service station. Prevailing wind directions are from the north. The average annual wind speed measured is 4 m/s (9 mph).

The average annual temperature at SNL is 13.4 °C (56.2 °F); average daily temperatures vary from a minimum of -5.7 °C (21.7 °F) in January to a maximum of 33.6 °C (92.5 °F) in July (NOAA 1994c:3).

The average annual precipitation at SNL is 22.6 cm (8.88 in). Most of the annual precipitation falls during the months of July through October and usually occurs from thunderstorm activity and the intrusion of warm, moist tropical air from the Gulf of Mexico. Snowfall averages nearly 28.2 cm (11.1 in). Snowfall has occurred from October through April. The maximum 24-hour rainfall was 4.9 cm (1.92 in) occurring in September 1955. On the average, the area can expect thunderstorms about 41 days per year (NOAA 1994c:3). The estimated probability of a tornado striking a point at SNL is 2.0x10 -5 per year (NRC 1986a:32).

Emission Rates. Table B.3.8-1 presents the emission rates for criteria and toxic/hazardous pollutants at SNL. These emission rates were used as input into the Industrial Source Complex Short-Term model, version 2, to estimate pollutant concentrations.

Modeling Assumptions. Additional model input used to estimate maximum pollutant concentrations at or beyond the SNL site boundary include the following: criteria pollutant emissions were modeled from actual stack locations using actual stack heights, stack diameter, exit velocity, and exit temperature, taken from operating permits; toxic/hazardous pollutant emissions were modeled from a centrally located stack in the SNL facility at a height of 10 m (32.8 ft), stack diameter of 0.3 m (1 ft), exit velocity of 0.03 m/s (0.1 ft/s), and exit temperature equal to ambient temperature.

Table B.3.8-1.-- Emission Rates for Proposed Stewardship and Management Alternatives at Sandia National Laboratories

Pollutant	2005 No Action (kg/yr)	Nonnuclear Fabrication (kg/yr)	National Ignition Facility (kg/yr)
Criteria Pollutant			
Carbon monoxide	23014	15	520
Nitrogen dioxide	1,070 14	15	2,150
Particulate matter	3,760 14	15	200
Sulfur dioxide	70 14	15	40
Total suspended particulates	15	15	15
Hazardous and Other Toxic Compounds			
Acetone	247	15	15
Benzene	1.1	15	15
Carbon tetrachloride	2.7	15	15
Hydrogen chloride	3,227	15	15
Isopropyl alcohol	106	15	15
Methanol	108	15	15

Methyl chloroform	703	15	15
Methylene chloride	40	15	15
Toluene	546	15	15
Trichloroethylene	103	15	15
Trichlorotrifluoroethane	151	15	15
Xylene	580	15	15

Atmospheric Dispersion Characteristics. Data collected at the Albuquerque National Weather Service station for 1991 indicate that unstable conditions occur approximately 28 percent of the time, neutral conditions approximately 38 percent of the time, and stable conditions approximately 34 percent of the time, on an annual basis.

Annual Mean Wind Speeds and Direction Frequencies. The Albuquerque National Weather Service meteorological data for annual mean wind speed and direction for 1991 are presented in figure B.3.8-1 as a wind rose. As shown in this figure, the maximum wind direction frequency is from the north with a secondary maximum from the east and south. The mean wind speed from the north is 4.1 m/s (9.2 mph); from the south is 4.8 m/s (10.7 mph); while the maximum mean wind speed is 6.4 m/s (14.3 mph) from the east.

B.3.9 Nevada Test Site

This section provides information on climatology and meteorology, modeling assumptions, atmospheric dispersion characteristics, and annual mean wind speeds and direction frequencies (figure B.3.9-1) at NTS. Table B.3.9-1 presents emission source inventories for criteria and toxic/hazardous pollutants at NTS. This information supports data presented in the environmental impacts section for air quality.

Climatology and Meteorology. Figure B.3.9-1 shows annual mean wind speed and wind direction frequencies for 1991 measured at the 10-m (32.8-ft) level of the Desert Rock, Nevada National Weather Service station. Prevailing winds are southerly during summer and northerly during winter. The general downward slope in the terrain from north to south results in an intermediate scenario that is reflected in the characteristic diurnal wind reversal from southerly winds during the day to northerly winds at night. This north-to-south reversal is strongest in the summer and, on occasion, becomes intense enough to override the wind regime associated with large-scale pressure systems.

Average annual wind speeds and direction vary with location. At higher elevations on Pahute Mesa, the average annual wind speed is 4.7 m/s (10.5 mph). The prevailing wind direction during winter months is north-northeasterly, and during summer months, is southerly. In Yucca Flat the average annual wind speed is 3.1 m/s (6.9 mph). The prevailing wind direction during winter months is north-northwesterly and during summer months is south-southwesterly. At Mercury, NV, the average annual wind speed is 3.6 m/s (8.1 mph), with northwesterly prevailing winds during the winter

months and southwesterly winds during the summer months (NT DOE 1994b:2-16).

Elevation influences temperatures on NTS. At an elevation of 2,000 m (6,560 ft) above mean sea level on Pahute Mesa, the average daily maximum/minimum temperatures are 4.4/-2.2 °C (40/28 °F) in January and 26.7/16.7 °C (80/62 °F) in July. In Yucca Flat, 1,195 m (3,920 ft) above mean sea level, the average daily maximum/minimum temperatures are 10.6/-6.1 °C (51/21 °F) in January and 35.6 /13.9 °C (96/57 °F) in July. The extreme temperatures at Mercury are 20.6/-11.1 °C (69/12 °F) in January and 42.8/15 °C (109/59 °F) in July (NT DOE 1993e:2-17,2-19).

The average annual temperature at the Las Vegas National Weather Service station is 19.5 °C (67.1 ° F); average daily temperature varies from a minimum of 0.9 °C (33.6 °F) in January to a maximum of 41.1 °C (105.9 °F) in July. The average annual precipitation at the Las Vegas National Weather Service station is 10.5 cm (4.13 in) (NOAA 1994d:3). Annual precipitation in southern Nevada is very light and depends largely upon elevation. On NTS, the mesas receive an average annual precipitation of 23 cm (9 in), which includes winter snow accumulations. The lower elevations receive approximately 15 cm (6 in) of precipitation annually, with occasional snow accumulations lasting only a few days (NT DOE 1993e:2-17,2-19).

Precipitation usually falls in isolated showers with large variations in precipitation amounts within a shower area. Summer precipitation occurs mainly in July and August when intense heating of the ground below moist air masses triggers thunderstorm development. On rare occasions, a tropical storm will move northeastward from the west coast of Mexico, bringing heavy precipitation during September and/or October.

Wind speeds in excess of 27 m/s (60 mph), with gusts up to 48 m/s (107 mph), may be expected to occur on a 100-year return period. Other than temperature extremes, severe weather in the region includes occasional thunderstorms, lightning, tornadoes, and sandstorms. Severe thunderstorms may produce high precipitation with durations of approximately 1 hour, and may create a potential for flash flooding (NT DOE 1983a:26). Tornadoes have been observed in the region but are infrequent. The estimated probability of a tornado striking a point at NTS is 3.0x10 -7 per year (NRC 1986a:32).

Emission Rates. Table B.3.9-1 presents the emission rates for criteria and toxic/hazardous pollutants at NTS. These emission rates were used as input into the Industrial Source Complex Short-Term model, version 2, to estimate pollutant concentrations.

Modeling Assumptions. Additional model input used to estimate maximum pollutant concentrations at or beyond the NTS site boundary include the following: criteria pollutant emissions were modeled from actual stack locations using actual stack heights, stack diameter, exit velocity, and exit temperature, taken from operating permits; toxic/hazardous pollutant emissions were modeled from a centrally located stack in the NTS facility at a height of 10 m (32.8 ft), stack diameter of 0.3 m (1 ft), exit velocity of 0.03 m/s (0.1 ft/s), and exit temperature equal to ambient temperature.

Table B.3.9-1.-- Emission Rates for Proposed Stewardship and Management Alternatives at Nevada Test Site

Pollutant	**2005 No Action 16 (kg/yr)**	**Assembly/ Disassembly (kg/yr)**	**National Ignition Facility (kg/yr)**
Criteria Pollutant			
Carbon monoxide	17	454	370
Hydrogen sulfide	17	17	17
Nitrogen dioxide	17	6,350	2,010
Particulate matter	86,820	136	80
Sulfur dioxide	71,125	6,804	4
Total suspended particulates	18	18	18
Hazardous and Other Toxic Compounds	17	17	17

Atmospheric Dispersion Characteristics. Data collected at the NTS meteorological monitoring station for 1991 indicate that unstable conditions occur approximately 26 percent of the time, neutral conditions approximately 37 percent of the time, and stable conditions approximately 37 percent of the time, on an annual basis.

Annual Mean Wind Speeds and Direction Frequencies. The NTS meteorological data for annual mean wind speed and direction for 1991 are presented in figure B.3.9-1 as a wind rose. As shown in this figure, the maximum wind direction frequency is from the northeast with a secondary maximum from the north-northeast. The mean wind speed from the northeast is 4.2 m/s (9.4 mph); from the north-northeast is 4.7 m/s (10.5 mph); while the maximum mean wind speed is 6.3 m/s (14.1 mph) from the south-southwest.

1

The NAAQS (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on average annuals, are not to be exceeded more than once per year. The ozone standard is attained when the expected number of days per year with maximum hourly average concentrations above the standard is less than or equal to one. The 24-hour particulate matter standard is attained when the expected number of days with a 24-hour average concentration above the standard is less than or equal to one. The annual arithmetic mean particulate matter standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard. The calendar quarter lead standard is not to be exceeded.

2

There is no standard.

NAAQS - National Ambient Air Quality Standard.

40 CFR 50; CA EPA 1993a; MO DNR 1994a; NM EIB 1996a; NV DCNR 1995a; SC DHEC 1992b; TN DEC 1994a; TX ACB 1987a; TX ACB 1993a; TX NRCC 1992a.

3

Based upon reduction of No Action emissions.

4

No sources indicated.

Parentheses indicate a net reduction in emissions.

OR DOE 1993a; OR DOE 1995g.

5

No sources indicated.

6

Data not available.

SRS 1993a:4; SRS 1995a:10; WSRC 1995c.

7

No sources indicated.

Parentheses indicate a net reduction in emissions.

PX 1996e:1, PX DOE 1996b; PX MH 1995a; PX MH 1995b.

8

No sources indicated.

9

It is assumed that PM *10* emissions are total suspended particulates emissions.

LANL 1995c; LANL 1995d; LANL 1995e; LANL 1995g; appendix I; appendix K.

10

Contained Firing Facility air emissions are addressed in appendix J.

11

No increase over No Action.

12

No sources indicated.

13

It is conservatively assumed that *particulate matter* emissions are total suspended particulates emissions.

LLNL 1995e; LLNL 1995f; LLNL 1995i:5; LLNL 1995j; appendix I; appendix J.

14

Based on steam plant and stand-by steam plant emissions.

15

No sources indicated.

SNL 1991b:1; SNL 1995e; appendix I.

16

Based on permitted sources.

17

No sources indicated.

18

No data available.

NT DOE 1995b; NV DCNR 1992a; appendix I.

APPENDIX C: THREATENED, ENDANGERED, AND SPECIAL STATUS SPECIES

This appendix contains tables C-1 through C-7 that present flora and fauna identified by the U.S. Fish and Wildlife Service (USFWS) and state governments as threatened, endangered, or other special status. Special status species include Federal candidate species and state classifications such as species of concern or species in need of management. The threatened, endangered, and special status lists include all such species which could potentially occur in a site area regardless of their residence status (i.e., breeding, year round, summer, winter, or migratory) or likelihood of being affected by project actions.

Table C-1.-- Federal- and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found at or in the Vicinity of Oak Ridge Reservation

Common Name	Scientific Name	Status 1	
		Federal	State
Mammals			
Alleghany woodrat	*Neotoma magister*	NL	D
Eastern cougar 2	*Felis concolor couguar*	E	E
Eastern small-footed bat	*Myotis leibii*	NL	D
Gray bat 2	*Myotis grisescens*	E	E
Indiana bat 2	*Myotis sodalis*	E	E
Rafinesque's big-eared bat	*Plecotus rafinesquii*	NL	D
River otter	*Lutra canadensis*	NL	T
Smoky shrew	*Sorex fumeus*	NL	D
Southeastern shrew	*Sorex longirostris*	NL	D
Birds			
American peregrine falcon 2	*Falco peregrinus anatum*	E	E
Appalachian Bewick's wren	*Thryomanes bewickii altus*	NL	T
Arctic peregrine falcon	*Falco peregrinus tundrius*	E(S/A)	E
Bachman's sparrow	*Aimophila aestivalis*	NL	E
Bald eagle 2, 3	*Haliaeetus leucocephalus*	T	T
Barn owl 4	*Tyto alba*	NL	D
Cooper's hawk 4,5	*Accipiter cooperii*	NL	D
Grasshopper sparrow	*Ammodramus savannarum*	NL	D
Northern harrier	*Circus cyaneus*	NL	D
Osprey 4	*Pandion haliaetus*	NL	T

Red-cockaded woodpecker	*Picoides borealis*	E	E
Sharp-shinned hawk 4, 5	*Accipiter striatus*	NL	D
Swainson's warbler	Limnothlypis swainsonii	NL	D
Reptiles			
Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*	NL	D
Northern pine snake	*Pituophis melanoleucus melanoleucus*	NL	T
Amphibians			
Hellbender 4,5	*Cryptobranchus alleganiensis*	NL	D
Tennessee cave salamander 6	*Gyrinophilus palleucus*	NL	T
Fish			
Alabama shad	*Alosa alabamae*	NL	D
Amber darter 2	*Percina antesella*	E	E
Blue sucker	*Cycleptus elongatus*	NL	T
Flame chub	*Hemitremia flammea*	NL	D
Frecklebelly madtom	*Noturus munitus*	NL	T
Highfin carpsucker	*Carpiodes velifer*	NL	D
Spotfin chub 2	*Cyprinella monacha*	T	E
Tennessee dace 4,5	*Phoxinus tennesseensis*	NL	D
Yellowfin madtom 2	*Noturus flavipinnis*	T	E
Invertebrates			
Alabama lampmussel 2	*Lampsilis virescens*	E	E
Appalachian monkeyface pearlymussel 2	*Quadrula sparsa*	E	E
Birdwing pearlymussel 2	*Conradilla caelata*	E	E
Cumberland bean pearlymussel 2	*Villosa trabalis*	E	E
Cumberland monkeyface pearlymussel 2	*Quadrula intermedia*	E	E
Dromedary pearlymussel 2	*Dromus dromas*	E	E
Fine-rayed pigtoe 2	*Fusconaia cuneolus*	E	E
Green-blossom pearlymussel 2	*Epioblasma torulosa gubernaculum*	E	E
Orange-footed pearlymussel 2	*Plethobasus cooperianus*	E	E
Painted snake coiled forest snail	*Anguispira picta*	T	E
Pale lilliput pearlymussel 2	*Toxolasma cylindrellus*	E	E
Pink mucket pearlymussel 2	*Lampsilis abrupta*	E	E
Rough pigtoe 2	*Pleurobema plenum*	E	E
Shiny pigtoe 2	*Fusconaia cor*	E	E
Tan riffle shell 2	*Epioblasma walkeri*	E	E
Tubercled-blossom pearlymussel 2	*Epioblasma torulosa torulosa*	E	E
Turgid-blossom pearlymussel 2	*Epioblasma turgidula*	E	E

White wartyback pearlymussel 2	*Plethobasus cicatricosus*	E	E
Yellow-blossom pearlymussel 2	*Epioblasma florentina florentina*	E	E
Plants			
American barberry	*Berberis canadensis*	NL	S
American ginseng 4,5	*Panax quinquefolius*	NL	T
Appalachian bugbane 4	*Cimicifuga rubifolia*	NL	T
Auriculate false-foxglove	*Tomanthera auriculata*	NL	E
Branching whitlowgrass	*Draba ramosissima*	NL	S
Butternut 4	*Juglans cinerea*	NL	T
Canada (wild yellow) lily 4,5	*Lilium canadense*	NL	T
Carey's saxifrage 4	*Saxifraga careyana*	NL	S
Fen orchid 4,5	*Liparis loeselii*	NL	E
Golden seal 4,5	*Hydrastis canadensis*	NL	T
Gravid sedge 4,5	*Carex gravida*	NL	S
Plants (Continued)			
Heartleaf meehania	*Meehania cordata*	NL	T
Heller's catfoot	*Gnaphalium helleri*	NL	S
Lesser ladies' tresses 4	*Spiranthes ovalis*	NL	S
Michigan lily 4,5	*Lilium michiganense*	NL	T
Mountain honeysuckle	Lonicera dioica	NL	S
Mountain witch alder 4	*Fothergilla major*	NL	T
Northern bush honeysuckle 4	*Diervilla lonicera*	NL	T
Nuttall waterweed 4	*Elodea nuttallii*	NL	S
Pink lady's-slipper 4,5	*Cypripedium acaule*	NL	E
Prairie goldenrod	Solidago ptarmicoides	NL	E
Purple fringeless orchid 4,5	*Platanthera peramoena*	NL	T
Slender blazing star	Liatris cylindracea	NL	E
Spreading false foxglove 4	*Aureolaria patula*	NL	T
Swamp lousewort	Pedicularis lanceolata	NL	T
Tall larkspur 4	*Delphinium exaltatum*	NL	E
Tennessee purple coneflower 2	*Echinacea tennesseenis*	E	E
Tubercled rein-orchid 4,5	*Platanthera flava var. herbiola*	NL	T
Virginia spiraea	*Spiraea virginiana*	T	E
Whorled mountainmint	Pycnanthemum verticillatum	NL	E-P

Table C-2.-- Federal- and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found at or in the Vicinity of Savannah River Site

Common Name	Scientific Name	Status 7	
		Federal	State
Mammals			
Meadow vole	Microtus pennsylvanicus	NL	SC
Rafinesque's big-eared bat 8	*Plecotus rafinesquii*	NL	SE
Southern Appalachian eastern woodrat 8	*Neotoma floridana haematoreia*	NL	SC
Spotted skunk 8	Spilogale putorius	NL	SC
Star-nosed mole 8	*Condylura cristata parva*	NL	SC
Swamp rabbit	*Sylvilagus aquaticus*	NL	SC
Birds			
American peregrine falcon8 , 9	*Falco peregrinus anatum*	E	SE
American swallow-tailed kite	*Elanoides forficatus*	NL	SE
Appalachian Bewick's wren 8	*Thryomanes bewickii altus*	NL	ST
Arctic peregrine falcon 8	*Falco peregrinus tundrius*	E (S/A)	ST
Bald eagle 9A	*Haliaeetus leucocephalus*	T	SE
Barn owl 8	Tyto alba	NL	SC
Common ground dove 8	*Columbina passerina*	NL	ST
Cooper's hawk 8	*Accipiter cooperii*	NL	SC
Kirtland's warbler 8	*Dendroica kirtlandii*	E	SE
Mississippi kite 8	*Ictinia mississippiensis*	NL	SC
Red-cockaded woodpecker 8,9A	*Picoides borealis*	E	SE
Red-headed woodpecker 8	*Melanerpes erythrocephalus*	NL	SC
Swainson's warbler 8	Limnothlypis swainsonii	NL	SC
Wood stork 8,10	*Mycteria americana*	E	SE
Reptiles			
American alligator 8	*Alligator mississippiensis*	T (S/A)	NL
Carolina swamp snake 8	*Seminatrix pygaea*	NL	SC
Eastern coral snake 8	*Micrurus fulvius fulvius*	NL	SC
Green water snake 8	Nerodia cyclopion	NL	SC
Spotted turtle 8	*Clemmys guttata*	NL	SC
Amphibians			
Carolina crawfish frog 8	*Rana areolata capito*	NL	SC

Eastern bird-voiced treefrog 8	*Hyla avivoca ogechiensis*	NL	SC
Eastern tiger salamander 8,10	*Ambystoma tigrinum tigrinum*	NL	SC
Northern cricket frog 8	Acris crepitans crepitans	NL	SC
Pickerel frog 8,10	*Rana palustris*	NL	SC
Upland chorus frog 8	*Pseudacris triseriata feriarum*	NL	SC
Fish			
Shortnose sturgeon 8,9A,10	*Acipenser brevirostrum*	E	SE
Invertebrates			
Brother spike mussel	*Elliptio fraterna*	NL	SE
Plants			
Beak-rush 8,10	*Rhynchospora inundata*	NL	SC
Bog spice bush 8	*Lindera subcoriacea*	NL	RC
Cypress stump sedge 8,10	*Carex decomposita*	NL	SC
Durand's white oak8	Quercus durandii	NL	SC
Dwarf bladderwort 8	*Utricularia olivacea*	NL	SC
Dwarf burhead8	Echinodorus parvulus	NL	SC
Elliott's croton 8	*Croton elliottii*	NL	SC
Few-fruited sedge 8	*Carex oligocarpa*	NL	SC
Florida bladderwort 8	*Utricularia floridana*	NL	SC
Florida false loosestrife 8	*Ludwigia spathulata*	NL	SC
Gaura 8	*Gaura biennis*	NL	SC
Green-fringed orchid 8,10	*Platanthera lacera*	NL	SC
Leafy pondweed 8	*Potamogeton foliosus*	NL	SC
Loose water-milfoil 8	*Myriophyllum laxum*	NL	RC
Milk-pea 8	*Astragalus villosus*	NL	SC
Nailwort 8,10	*Paronychia americana*	NL	SC
Nestronia 8	Nestronia umbellula	NL	SC
Nutmeg hickory 8	*Carya myristiciformis*	NL	RC
Oconee azalea 8	*Rhododendron flammeum*	NL	SC
Pink tickseed 8	*Coreopsis rosea*	NL	RC
Quill-leaved swamp potato 8	*Sagittaria isoetiformis*	NL	SC
Sandhill lily 8	*Nolina georgiana*	NL	SC
Smooth coneflower 8	*Echinacea laevigata*	E	-- *e*
Trepocarpus 8	*Trepocarpus aethusae*	NL	SC
Wild water-celery 8	*Vallisneria americana*	NL	SC
Yellow cress 8	*Rorippa sessiliflora*	NL	SC
Yellow wild indigo 8	*Baptisia lanceolata*	NL	SC

Table C-3.-- Federal- and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found at or in the Vicinity of Pantex Plant

		Status 10	
Common Name	Scientific Name	Federal	State
Mammals			
Swift fox 11	*Vulpes velox*	C	NL
Birds			
American peregrine falcon 12	*Falco peregrinus anatum*	E	E
Arctic peregrine falcon	*Falco peregrinus tundrius*	E (S/A)	T
Bald eagle *11, 12*	*Haliaeetus leucocephalus*	T	E
Interior least tern *12*	*Sterna antillarum athalassos*	E	E
Mountain plover	*Charadrius montanus*	C	NL
White-faced ibis *11*	*Plegadis chihi*	NL	T
Whooping crane *11,12*	*Grus americana*	E	E
Reptiles			
Smooth green snake	*Opheodrys vernalis*	NL	E
Texas horned lizard *11*	*Phrynosoma cornutum*	NL	T

Table C-4.-- Federal- and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found at or in the Vicinity of Los Alamos National Laboratory

Common Name	Scientific Name	Status 13	
		Federal	State
Mammals			
New Mexican meadow jumping mouse	*Zapus hudsonius luteus*	NL	T
Spotted bat	*Euderma maculatum*	NL	T
Birds			
Baird's sparrow	Ammodvamus bairdii	NL	T
Bald eagle 14 , 15	*Haliaeetus leucocephalus*	T	T
Broad-billed hummingbird	*Cynanthus latirostris*	NL	T
Common black-hawk	*Beuteogallus anthracinus*	NL	T
Gray vireo	*Vireo vicinior*	NL	T

Mexican spotted owl 15	*Strix occidentalis lucida*	T	NL
Peregrine falcon 14,15	*Falcon peregrinus*	E (S/A)	E
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	T
Whooping crane 14	*Grus americana*	E	E
Amphibians			
Jemez Mountain salamander 15	*Plethodon neomexicanus*	NL	T
Fish			
Rio Grande silvery minnow	*Hybognathus amarus*	E	T
Invertebrates			
Say's pond snail	*Lymnaea caperata*	NL	E
Plants			
Checker lily	Fritillaria atropurpurea	NL	R
Giant helleborine orchid	*Epipactis gigantea*	NL	RS
Golden lady's slipper	Cypripedium pubesceas	NL	E
Sandia alumroot	*Heuchera pulchella*	NL	RS
Santa Fe cholla	*Opuntia viridiflora*	NL	E
Wood lily	*Lilium philadelphicum var. andinum*	NL	E

Table C-5.-- Federal- and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found at or in the Vicinity of the Livermore Site and Site 300

Common Name	Scientific Name	Status 16	
		Federal	State
Mammals			
American badger 17	*Taxidea taxus*	NL	SC
Greater western mastiff-bat	*Eumops perotis californicus*	NL	SC
Pacific Townsend's big-eared bat	*Plecotus townsendii townsendii*	NL	SC
Riparian brush rabbit	Sylvilagus bachmani riparius	C	E
San Francisco dusky-footed woodrat	Neotoma fuscipes annectens	NL	SC
San Joaquin kit fox 20	*Vulpes macrotis mutica*	E	T
San Joaquin pocket mouse 17	*Perognathus inoratus inoratus*	NL	SC
San Joaquin Valley woodrat	*Neotoma fuscipes riparia*	C	SC
Birds			
American peregrine falcon 17,20	*Falco peregrinus anatum*	E	E
Bald eagle c,d	*Haliaeetus leucocephalus*	T	E

Bell's sage sparrow	Amphispiza belli belli	NL	SC
California horned lark 17	Eremophila alpestris actia	NL	SC
Coopers hawk 17,d	*Accipiter cooperii*	NL	SC
Double-crested cormorant *d*	Phalacrocorax auritus	NL	SC
Ferruginous hawk 17,*d*	Buteo regalis	NL	SC
Golden eagle 17,*d*	*Aquila chrysaetos*	NL	SC
Long-eared owl 17	Asio otus	NL	SC
Merlin 17,*d*	Falco columbarius	NL	SC
Mountain plover	Charadrius montanus	C	NL
Northern harrier 17,*d*	*Circus cyaneus*	NL	SC
Prairie falcon 17,*d*	*Falco mexicanus*	NL	SC
Sharp-shinned hawk *d*	*Accipiter striatus*	NL	SC
Short-eared owl	*Asio flammeus*	NL	SC
Swainson's hawk 17	*Buteo swainsoni*	NL	T
Tricolored blackbird 17	*Agelaius tricolor*	NL	SC
Western burrowing owl 17,*d*	*Athene cunicularia hypugea*	NL	SC
Reptiles			
Alameda whipsnake 17	*Masticophis lateralis euryxanthus*	PE	T
California horned lizard 17	*Phrynosoma coronatum frontale*	NL	SC
Giant garter snake	Thamnophis gigas	T	T
Northwestern pond turtle	Clemmys marmorata marmorata	NL	SC
San Joaquin whipsnake 17	Masticophis flagellum ruddocki	NL	SC
Silvery legless lizard	Anniella pulchra pulchra	NL	SC
Southwestern pond turtle	Clemmys marmorata pallida	NL	SC
Amphibians			
California red-legged frog 17	*Rana aurora draytoni*	PE	SC
California tiger salamander 17	*Ambystoma californiense*	C	SC
Western spadefoot toad 17	Scaphiopus hammondii	NL	SC
Invertebrates			
Longhorn fairy shrimp	*Branchinecta longiantenna*	E	NL
Valley elderberry longhorn beetle 17	*Desmocerus californicus dimorphus*	T	SC
Vernal pool fairy shrimp	Branchinecta lynchi	T	NL
Vernal pool tadpole shrimp *e*	Lepidurus packardi	E	NL
Plants			
Alkali milkvetch	Astragalus tener tener	NL	SC
Big scale balsamroot	Balsamorhiza macrolepis var. macrolepis	NL	SC
Congdon's tarplant	Hemizonia parryi congdonii	NL	SC

Large-flowered fiddleneck 17	*Amsinckia grandiflora*	E	E
Palmate-bracted bird's beak	*Cordylanthus palmatus*	E	E
Showy Indian clover	*Trifolium amoenum*	PE	NL
Stinkbells	Fritillaria agrestis	NL	SC

Table C-6.-- Federal- and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found at or in the Vicinity of Sandia National Laboratories

Common Name	Scientific Name	Status 18	
		Federal	State
Mammals			
New Mexican meadow jumping mouse	*Zapus hudsonius luteus*	NL	T
Spotted bat	*Euderma maculatum*	NL	T
Birds			
Bald eagle 19	*Haliaeetus leucocephalus*	T	T
Baird's sparrow	Ammodramus bairdii	NL	T
Bell's vireo	Vireo bellii	NL	T
Common black hawk	Beuteogallus anthracinus	NL	T
Gray vireo 20	Vireo vicinior	NL	T
Mexican spotted owl	Strix occidentalis lucida	T	NL
Mountain plover	*Charadrius montanus*	C	NL
Northern beardless-tyrannulet	Camptostoma imperbe	NL	E
Peregrine falcon 19	Falco peregrinus	E (S/A)	E
Southwestern willow flycatcher	Empidonax traillii extimus	E	T
Whooping crane 19	Grus americana	E	E
Fish			
Rio Grande silvery minnow	Hybognathus amarus	E	T
Plants			
Great Plains lady tresses	Spiranthes magnicamporum	NL	E
Plank's catchfly	Silene plankii	NL	RS
Santa Fe milkvetch	Astragalus feensis	NL	RS
Strong prickly pear	Opuntia valida	NL	R

Table C-7.-- Federal- and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found at or in the Vicinity of Nevada Test Site

Common Name	Scientific Name	Status 21	
		Federal	State
Mammals			
Spotted bat 22	*Euderma maculatum*	NL	T
Birds			
American peregrine falcon 23 , 24	*Falco peregrinus anatum*	E	E
Arctic peregrine falcon 23	*Falco peregrinus tundrius*	E (S/A)	E
Bald eagle 22,24	*Haliaeetus leucocephalus*	T	T
Mountain plover 22	*Charadrius montanus*	C	NL
Reptiles			
Desert tortoise 22, 25	*Gopherus agassizii*	T	T
Fish			
Devils Hole pupfish 24, 26	*Cyprinodon diabolis*	E	E
Plants			
Beatley milkvetch 22	*Astragalus beatleyae*	NL	CE
Mojave fishhook cactus 22	*Sclerocactus polyancistrus*	NL	CY

1

Status codes: D - deemed in need of management; E - endangered; NL - not listed; P - possibly extirpated; S - species of special concern; S/A - protected under the similarity of appearances provision of the *Endangered Species Act* ; T - threatened.

2

USFWS Recovery Plan exists for this species.

3

Observed near Oak Ridge Reservation (ORR) on Melton Hill and Watts Bar Lakes.

4

Recent record of species occurrence on ORR.

5

Species known to occur on or near proposed project site.

6

Species collected on ORR in 1964.

50 CFR 17.11; 50 CFR 17.12; DOE 1995w; OR DOE 1990a; OR FWS 1992b; OR NERP 1993a; ORNL 1981a;
ORNL 1984b; ORNL 1988c; TN DEC 1995a; TN DEC 1995b; TN DEC 1995c; TN DEC 1995d; TN WRC 1991a;
TN WRC 1991b.

7

Status codes: E - endangered; NL - not listed; RC - regional of concern (unofficial plants only); S/A - protected under the similarity of appearance provision of the Endangered Species Act; SC - state of concern; SE - state endangered (official state-listed animals only); ST - state threatened (official state-list animals only); and T - threatened.

8

Species occurrence recorded on Savannah River Site (SRS).

9

USFWS Recovery Plan exists for this species.

9A

Species known to occur on Upper Three Runs Creek downstream from the proposed project site or in areas affected by the project.

9B

There is no official state threatened or endangered status for plants; defer to Federal status.

50 CFR 17.11; 50 CFR 17.12; DOE 1992e; SC WD 1995a; SR NERP 1990b; WSRC 1989e; WSRC 1993b.

10

Status codes: C - Federal candidate; E - endangered; NL - not listed; S/A - protected under the similarity of appearances provision of the *Endangered Species Act* ; T - threatened.

11

Species observed on Pantex Plant.

12

USFWS Recovery Plan exists for this species.

50 CFR 17.11; 50 CFR 17.12; 61 FR 7596; PX DOE 1996b; PX MH 1994c; TX PWD 1993a; TX PWD 1995a;
TX PWD 1995b.

13

Status codes: E - endangered; NL - not listed; R - state rare plant review list; RS - state rare and sensitive plant species; S/A - protected under the similarity of appearances provision of the Endangered Species Act; T - threatened.

14

USFWS Recovery Plan exists for this species.

15

Species recorded on Los Alamos National Laboratory (LANL).

50 CFR 17.11; 50 CFR17.12; DOE 1995hh; LANL 1996e:2; NM DGF 1990b; NM DGF 1995a; NM FRCD 1995a.

16

Status codes: C - Federal candidate; E - endangered species; NL - not listed; PE - proposed endangered; SC - state species of special concern; T - threatened.

17

Species considered only for Site 300.

50 CFR 17.11; 50 CFR 17.12; 61 FR 7596; CA DFG 1994a; CA DFG 1995a; CA DFG 1995b; CA DFG 1995c;
LL DOE 1992c; LLNL 1996i:3.

18

Status codes: C - Federal candidate; E - endangered; NL - not listed; R - state rare plant review list; RS - state rare and sensitive plant species; S/A - protected under the similarity of appearance provision of the *Endangered Species Act* ; T - threatened.

19

USFWS Recovery Plan exists for this species.

20

Species observed on Sandia National Laboratory (SNL).

50 CFR 17.11; 50 CFR 17.12; 61 FR 7596; NM DGF 1990b; NM DGF 1995a; NM FRCD 1995a; SNL 1990a; SNL 1992c; SNL 1995h; appendix I.

21

Status codes: C - Federal candidate; CE - critically endangered by authority of NRS 527.270 (State Division of Forestry); CY - protected by authority of NRS 522.60-.120 (Nevada Cacti and Yucca Law); E - endangered; NL - not listed; S/A - protected under the similarity of appearances provision of the *Endangered Species Act* ; T - threatened.

22

Species recorded on Nevada Test Site (NTS).

23

Peregrine falcon seen on NTS; however not identified to subspecies level.

24

USFWS Recovery Plan exists for this species.

25

Species known to occur on the proposed project site.

26

Only known location of this species is outside NTS approximately 55 km (34 mi) southwest of the proposed project site. This species is included here due to offsite groundwater concerns.

50 CFR 17.11; 50 CFR 17.12; 61 FR 7596; DOE 1995w; NT DOE 1995j; NT DOE 1996c; NT DOI 1995a; NT ERDA 1976a; NV FWS 1989a; NV NHP 1995a.

APPENDIX D: SOCIOECONOMICS

D.1 Introduction

This appendix includes the methodologies, models, assumptions, and supporting data used to assess potential impacts in the socioeconomics sections of this programmatic environmental impact statement. Section D.2 presents the methods and assumptions used to evaluate the potential socioeconomic effects of the proposed alternatives of the Stockpile Stewardship and Management Program. The socioeconomic analysis involved two major steps: (1) characterizing and projecting existing social, economic, and infrastructure conditions surrounding each of the candidate sites (i.e., the affected environment); and (2) evaluating potential changes in socioeconomic conditions that could result from operating the proposed alternatives in the regions addressed (i.e., the environmental consequences).

For each site, socioeconomic impacts were estimated using two geographic areas. First, a region of influence (ROI) was identified based on the distribution of residences for current Department of Energy (DOE) and contractor employees. The ROI is defined as those counties where approximately 90 percent of the workforce lives. This residential distribution reflects existing commuting patterns and attractiveness of area communities for people employed at each site, and was used to estimate the future distribution of direct workers associated with the proposed alternatives.

As an example, table D.1-1 displays the residential distribution by city and county for approximately 90 percent of all personnel employed at Oak Ridge Reservation (ORR). Data on residential locations of a large portion of facility employees were obtained from ORR personnel offices. Similar data were provided by the other locations and are given in tables D.1-2 through D.1-8.

Table D.1-1.-- Distribution of Employees by Place of Residence in the Oak Ridge Reservation Region of Influence, 1991

County/City	Number of Employees	Total Site Employment (percent)
Anderson County	5,053	33.1
Clinton	1,035	6.8
Oak Ridge	3,292	21.6
Knox County	5,490	36.0
Knoxville	4,835	31.7

Loudon County	848	5.6
Lenoir City	638	4.2
Roane County	2,537	16.6
Harriman	802	5.3
Kingston	1,033	6.8
Total ROI	13,928	91.3
City values are included within county totals. **ORR 1991a:4.**		

Table D.1-2.-- Distribution of Employees by Place of Residence in the Savannah River Site Region of Influence, 1991

County/City	Number of Employees	Total Site Employment (percent)
Aiken County	9,978	51.9
Aiken	4,928	25.7
North Augusta	2,666	13.9
Barnwell County	1,401	7.3
Columbia County	2,036	10.6
Richmond County	3,358	17.5
Augusta	2,780	14.5
Total ROI	16,773	87.3

City values are included within county totals. **SRS 1991a:3.**

Table D.1-3.-- Distribution of Employees by Place of Residence in the Kansas City Plant Region of Influence, 1991

County/City	Number of Employees	Total Site Employment (percent)
Cass County	761	14.0
Belton	237	4.4
Harrisonville	150	2.8
Jackson County	3,246	59.8
Kansas City	1,499	27.6
Lee's Summit	609	11.2
Johnson County	915	16.9
Overland Park	376	6.9
Wyandotte County	135	2.3
Total ROI	5,057	93.2
City values are included within county totals. **KCP 1993a:1.**		

Table D.1-4.-- Distribution of Employees by Place of Residence in the Pantex Plant Region of Influence, 1994

County/City	Number of Employees	Total Site Employment (percent)
Armstrong County	46	1.3
Carson County	380	10.7
Potter County	1,217	34.2
Amarillo	196	5.5
Randall County	1,783	50.2
Total ROI	3,426	96.4
City values are included within county totals. **PX 1994a:2.**		

Table D.1-5.-- Distribution of Employees by Place of Residence in the Los Alamos National Laboratory Region of Influence, 1991

County/City	Number of Employees	Total Site Employment (percent)
Los Alamos County	4,697	48.3
Rio Arriba County	2,027	20.8
Espanõla	944	9.7
Santa Fe County	1,851	19.0
Santa Fe	1,548	15.9

Total ROI	8,575	88.1
City values are included within county totals. **LANL 1991b:6.**		

Table D.1-6.-- Distribution of Employees by Place of Residence in the Lawrence Livermore National Laboratory Region of Influence, 1995

County/City	Number of Employees	Total Site Employment (percent)
Alameda County	4,746	57.1
Livermore	3,215	38.7
Pleasanton	642	7.7
Contra Costa County	1,098	13.2
San Joaquin County	1,327	16.0
Manteca	372	4.5
Tracy	656	7.9
Total ROI	7,171	86.3
City values are included within county totals. **LLNL 1995i:1.**		

Table D.1-7.-- Distribution of Employees by Place of Residence in the Sandia National Laboratories Region of Influence, 1994

County/City	Number of Employees	Total Site Employment (percent)

Bernalillo County	6,463	88.0
Albuquerque	6,030	82.1
Sandoval County	333	4.5
Valencia County	334	4.5
Total ROI	7,130	97.0
City values are included within county totals. **SNL 1995b:1.**		

Table D.1-8.-- Distribution of Employees by Place of Residence in the Nevada Test Site Region of Influence, 1991

County/City	**Number of Employees**	**Total Site Employment (percent)**
Clark County	6,270	81.7
Henderson	357	4.7
Las Vegas	5,352	69.7
North Las Vegas	505	6.6
Nye County	1,173	15.3
Total ROI	7,443	97.0
City values are included within county totals. **NTS 1991a:1.**		

A second geographical area, referred to as a regional economic area, was also identified for estimating socioeconomic impacts. The regional economic area encompasses a broad market that involves trade among regional industrial and service sectors and is characterized by strong economic

links between the communities located in the region. These links determine the nature and magnitude of multiplier effects of economic activity at each candidate site. Regional economic areas, as defined by the U.S. Bureau of Economic Analysis, consist of an economic node that serves as the center of economic activity, and surrounding counties that are economically related and include the places of work and residence of its labor force. The regional economic area is used to analyze the primary economic impacts on employment, spending, earnings, and personal income. Table D.1-9 displays the counties found in each site's regional economic area.

Data for the year 1992 or later were obtained from sources such as the U.S. Bureau of Census, the U.S. Bureau of Economic Analysis (BEA), state and local government publications, and telephone interviews with state and local government officials and planners.

Table D.1-9.-- Candidate Sites' Regional Economic

ORR	SRS	KCP			Pantex		LANL
Tennessee	Georgia	Kansas	Missouri (Con't)	Missouri (Con't)	New Mexico	Texas (Con't)	New Mexico
Anderson	Burke	Anderson	Caldwell	Livingston	Curry	Gray	Guadalupe
Blount	Columbia	Atchison	Carroll	Macon	Debaca	Hall	Los Alamos
Campbell	Glascock	Bourbon	Cass	Mercer	Harding	Hansford	Mora
Cocke	Jefferson	Doniphan	Cedar	Nodaway	Quay	Hartley	Rio Arrib
Grainger	Jenkins	Douglas	Chariton	Pettis	Roosevelt	Hemphill	San Miguel
Hamblen	Lincoln	Franklin	Clay	Platte	Union	Hutchinson	Santa Fe
Hancock	McDuffie	Johnson	Clinton	Putnam		Lipscomb	Taos
Jefferson	Richmond	Leavenworth	Davies	Ray		Moore	
Knox	Warren	Linn	De Kalb	Saline	Texas	Ochiltree	
Loudon	Wilkes	Miami	Gentry	Schuyler	Armstrong	Oldham	
Morgan		Wyandotte	Grundy	St. Clair	Bailey	Parmer	
Roane			Harrison	Sullivan	Carson	Potter	
Scott	South Carolina		Henry	Vernon	Castro	Randall	
Sevier	Aiken	Missouri	Holt	Worth	Childress	Roberts	
Union	Allendale	Adair	Jackson		Collingsworth	Sherman	
	Bamberg	Andrew	Johnson		Cottle	Wheeler	
	Barnwell	Bates	Knox		Dallam		

Edgefield	Benton	Lafayette	Deaf Smith
	Buchanan	Linn	Donley

DOC 1995a.

D.2 Methodologies and Models

D.2.1 Employment and Population

The description of socioeconomic conditions includes indicators, such as population, civilian labor force, employment, unemployment rate, and income. These indicators provide a basis for comparing baseline projections of the affected regions to estimates of project-induced impacts. These baseline projections depict the No Action alternative. The baseline projections are derived from forecasts for the project period developed with data from BEA.

An analysis of the existing labor availability was performed to determine the number of workers that would be needed to come from outside the region. In addition to jobs created directly by the proposed project alternatives, other jobs and opportunities are created indirectly within the region. These indirect jobs and resulting income are measured by employing the most recent version of the Regional Input-Output Modeling System developed by BEA. For this analysis, direct effect multipliers were used to determine project-related additional indirect workers and earnings increases. Final demand multipliers were not used because there were not sufficient data on purchases. Population increases due to the in-migration of new workers and their families are estimated by the number of new workers and the national average household size because this new population would come from unknown places outside the region.

Total employment and local economic data for all the sites are given in tables D.2.1-1 through D.2.1-8. Population data for all the sites are given in tables D.2.1-9 through D.2.1-16.

Table D.2.1-1.-- Employment and Local Economy for the Oak Ridge Reservation Regional Economic Area, No Action Alternative, 1995-2030

Regional Economic Area	1995	2000	2005	2010	2020	2030
Civilian labor force	486,400	513,600	535,800	555,300	594,000	601,300
Total employment	462,900	488,700	509,800	528,400	565,200	572,100
Unemployment rate (percentage)	4.9	4.9	4.9	4.9	4.9	4.9
Total personal income (thousand dollars)	16,498,303	18,391,177	20,017,623	21,498,098	24,601,119	25,206,968

Per capita income (dollars per person)	18,198	19,214	20,046	20,774	22,223	22,494
Census 1993a; Census 1993b; DOC 1990c; DOC 1990d; DOC 1994j; DOC 1995a; DOL 1991a; DOL 1995a; OR LMES 1996i; ORR 1995a:1.						

Table D.2.1-2.-- Employment and Local Economy for the Savannah River Site Regional Economic Area, No Action Alternative, 1995-2030

Regional Economic Area	**1995**	**2000**	**2005**	**2010**	**2020**	**2030**
Civilian labor force	261,400	278,100	292,300	306,100	335,600	338,500
Total employment	243,800	259,400	272,700	285,500	313,000	315,800
Unemployment rate (percentage)	6.7	6.7	6.7	6.7	6.7	6.7
Total personal income (thousand dollars)	10,608,794	12,013,250	13,269,987	14,550,516	17,487,856	17,798,751
Per capita income (dollars per person)	17,789	18,930	19,895	20,833	22,839	23,041
Census 1993a; Census 1993c; Census 1993e; DOC 1990c; DOC 1990d; DOC 1994j; DOC 1995a; DOE 1995p; DOL 1991a; DOL 1995a; SR DOE 1995b; SRS 1995a:1.						

Table D.2.1-3.-- Employment and Local Economy for the Kansas City Plant Regional Economic Area, No Action Alternative, 1995-2030

Regional Economic Area	**1995**	**2000**	**2005**	**2010**	**2020**	**2030**
Civilian labor force	1,215,800	1,255,900	1,296,200	1,338,900	1,428,200	1,444,000

Total employment	1,156,200	1,194,400	1,232,700	1,273,400	1,358,300	1,373,300
Unemployment rate (percentage)	4.9	4.9	4.9	4.9	4.9	4.9
Total personal income (thousand dollars)	46,020,762	49,151,226	52,309,800	55,815,538	63,506,729	64,919,757
Per capita income (dollars per person)	20,004	20,683	21,327	22,030	23,499	23,759
Census 1993a; Census 1993q; Census 1993t; DOC 1990c; DOC 1990d; DOC 1994j; DOC 1995a; DOL 1991a; DOL 1995a; KCP 1995a:1.						

Table D.2.1-4.-- Employment and Local Economy for the Pantex Plant Regional Economic Area, No Action Alternative, 1995-2030

Regional Economic Area	1995	2000	2005	2010	2020	2030
Civilian labor force	234,700	247,800	261,100	274,800	302,300	302,000
Total employment	223,300	235,800	248,400	261,500	287,700	287,400
Unemployment rate (percentage)	4.8	4.8	4.8	4.8	4.8	4.8
Total personal income (thousand dollars)	9,622,309	10,728,135	11,908,766	13,190,906	15,965,800	15,933,429
Per capita income (dollars per person)	19,987	21,104	22,235	23,401	25,745	25,719

Census 1993a; Census 1993m; Census 1993w; DOC 1990c; DOC 1990d; DOC 1994j; DOC 1995a; DOL 1991a; DOL 1995a; PX 1995a:2.

Table D.2.1-5.-- Employment and Local Economy for the Los Alamos National Laboratory Regional Economic Area, No Action Alternative, 1995-2030

Regional Economic Area	1995	2000	2005	2010	2020	2030
Civilian labor force	119,700	130,800	140,900	150,400	169,400	175,200
Total employment	112,300	122,700	132,200	141,100	158,900	164,400
Unemployment rate (percentage)	6.2	6.2	6.2	6.2	6.2	6.2
Total personal income (thousand dollars)	4,218,781	5,034,646	5,845,041	6,655,720	8,440,189	9,034,538
Per capita income (dollars per person)	18,314	20,007	21,557	23,003	25,904	26,801

Census 1993a; Census 1993m; DOC 1990c; DOC 1990d; DOC 1994j; DOC 1995a; DOL 1991a; DOL 1995a; LANL 1995b:1.

Table D.2.1-6.-- Employment and Local Economy for the Lawrence Livermore National Laboratory Regional Economic Area, No Action Alternative, 1995-2030

Regional Economic Area	1995	2000	2005	2010	2020	2030
Civilian labor force	4,556,000	5,004,100	5,448,100	5,917,500	6,992,100	7,097,200
Total employment	4,208,100	4,621,900	5,032,000	5,465,600	6,458,200	6,555,300

Unemployment rate (percentage)	7.6	7.6	7.6	7.6	7.6	7.6
Total personal income (thousand dollars)	236,627,513	285,131,842	337,968,862	398,727,427	556,687,763	573,557,669
Per capita income (dollars per person)	26,716	29,310	31,910	34,660	40,954	41,570
Census 1993a; Census 1993x; DOC 1990c; DOC 1990d; DOC 1994j; DOC 1995a; DOL 1991a; DOL 1995a; LLNL 1995i:1.						

Table D.2.1-7.-- Employment and Local Economy for the Sandia National Laboratories Regional Economic Area, No Action Alternative, 1995-2030

Regional Economic Area	1995	2000	2005	2010	2020	2030
Civilian labor force	408,300	446,100	480,600	512,900	577,500	597,500
Total employment	385,200	420,900	453,500	483,900	544,900	563,800
Unemployment rate (percentage)	5.7	5.7	5.7	5.7	5.7	5.7
Total personal income (thousand dollars)	14,923,362	17,809,373	20,676,034	23,543,700	29,856,016	31,958,442
Per capita income (dollars per person)	17,676	19,310	20,806	22,202	25,002	25,867
Census 1993a; Census 1993f; Census 1993m; DOC 1990c; DOC 1990d; DOC 1994j; DOC 1995a; DOL 1991a; DOL 1995a; SNL 1995b:1.						

Table D.2.1-8.-- Employment and Local Economy for the Nevada Test Site Regional Economic Area, No Action Alternative, 1995-2030

Regional Economic Area	1995	2000	2005	2010	2020	2030
Civilian labor force	648,600	747,100	814,100	861,900	959,500	993,200
Total employment	608,900	701,400	764,300	809,100	900,800	932,400
Unemployment rate (percentage)	6.1	6.1	6.1	6.1	6.1	6.1
Total personal income (thousand dollars)	27,397,938	36,357,995	43,164,854	48,380,917	59,961,996	64,253,190
Per capita income (dollars per person)	22,083	25,438	27,718	29,345	32,669	33,817
Census 1993a; Census 1993f; Census 1993y; Census 1993z; DOC 1990c; DOC 1990d; DOC 1994j; DOC 1995a; DOL 1991a; DOL 1995a; NTS 1995a:1.						

Table D.2.1-9.-- Population for the Oak Ridge Reservation Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030
Anderson County	73,300	77,400	80,800	83,700	89,500	90,600
Clinton	9,900	10,400	10,900	11,300	12,000	12,200

Oak Ridge	26,300	27,800	29,000	30,000	32,100	32,500
Knox County	361,400	381,500	398,100	412,500	441,300	446,700
Knoxville	173,900	183,600	191,600	198,500	212,400	215,000
Loudon County	34,600	36,500	38,100	39,500	42,200	42,700
Lenoir City	7,100	7,500	7,800	8,100	8,600	8,700
Roane County	50,000	52,800	55,100	57,100	61,100	61,800
Harriman	7,400	7,900	8,200	8,500	9,100	9,200
Kingston	4,800	5,100	5,300	5,500	5,900	6,000
Total ROI	519,300	548,200	572,100	592,800	634,100	641,800

City values are included in county totals.

Census 1993a; Census 1993b; DOC 1990c; DOC 1990d; DOC 1994j.

Table D.2.1-10.--Population for the Savannah River Site Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030
Aiken County	135,300	144,000	151,300	158,500	173,700	175,300
Aiken	23,600	25,100	26,400	27,600	30,300	30,600
North Augusta	17,200	18,300	19,300	20,200	22,100	22,300
Barnwell County	22,200	23,600	24,800	26,000	28,500	28,700
Columbia County	76,800	81,800	85,900	90,000	98,600	99,500
Richmond County	213,000	226,700	238,300	249,500	273,400	275,900
Augusta	46,800	49,800	52,300	54,800	60,100	60,600
Total ROI	447,300	476,100	500,300	524,000	574,200	579,400

City values are included in county totals.

Census 1993a; Census 1993c; Census 1993e; DOC 1990c; DOC 1990d; DOC 1994j.

Table D.2.1-11.--Population for the Kansas City Plant Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030
Cass County	68,700	70,900	73,200	75,600	80,700	81,600
Belton	19,800	20,400	21,100	21,800	23,200	23,500
Harrisonville	8,200	8,500	8,800	9,100	9,700	9,800
Jackson County	645,400	666,700	688,100	710,800	758,200	766,600
Kansas City	439,300	453,800	468,400	483,800	516,000	521,800
Lee's Summit	52,200	54,000	55,700	57,500	61,400	62,100
Johnson County	381,900	394,500	407,100	420,600	448,600	453,600
Overland Park	121,400	125,400	129,400	133,700	142,600	144,200
Wyandott County	161,600	166,900	172,200	177,900	189,800	191,900
Total ROI	1,257,600	1,299,000	1,340,600	1,384,900	1,477,300	1,493,700

City values are included in county totals. Census 1993a; Census 1993q; Census 1993t; DOC 1990c; DOC 1990d; DOC 1994j.

Table D.2.1-12.-- Population for the Pantex Plant Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030
Armstrong County	2,100	2,200	2,300	2,500	2,700	2,700
Carson County	6,800	7,200	7,600	8,000	8,800	8,800
Potter County	105,000	110,900	116,800	122,900	135,200	135,100
Amarillo	169,500	179,000	188,600	198,500	218,400	218,100
Randall County	96,700	102,100	107,600	113,200	124,500	124,400
Total ROI	210,600	222,400	234,300	246,600	271,200	271,000
Amarillo is divided across Potter and Randall Counties. The population shown for Amarillo is for the whole city. Potter and Randall County totals represent their share of Amarillo. Census 1993a; Census 1993w; DOC 1990c; DOC 1990d; DOC 1994j.						

Table D.2.1-13.--Population for the Los Alamos National Laboratory Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030

Los Alamos County	19,200	21,000	22,600	24,200	27,200	28,200
Rio Arriba County	36,900	40,300	43,500	46,400	52,200	54,000
Espanola	9,600	10,400	11,200	12,000	13,500	14,000
Santa Fe County	111,300	121,600	131,000	139,800	157,500	162,900
Santa Fe	62,500	68,200	73,500	78,400	88,300	91,400
Total ROI	167,400	182,900	197,100	210,400	236,900	245,100
City values are included in county totals. Census 1993a; Census 1993m; DOC 1990c; DOC 1990d; DOC 1994j.						

Table D.2.1-14.--Population for the Lawrence Livermore National Laboratory Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030
Alameda County	1,400,700	1,536,800	1,673,100	1,817,300	2,147,300	2,179,600
Livermore	64,300	70,600	76,800	83,500	98,600	100,100
Pleasanton	58,100	63,700	69,400	75,400	89,000	90,400

Contra Costa County	900,500	987,900	1,075,600	1,168,200	1,380,400	1,401,200
San Joaquin County	540,000	592,400	645,000	700,600	827,800	840,300
Manteca	45,500	49,900	54,300	59,000	69,700	70,800
Tracy	41,900	46,000	50,100	54,400	64,300	65,200
Total ROI	2,841,200	3,117,100	3,393,700	3,686,100	4,355,500	4,421,000

City values are included in county totals.

Census 1993a; Census 1993x; DOC 1990c; DOC 1990d; DOC 1994j.

Table D.2.1-15.--Population for the Sandia National Laboratories Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030
Bernalillo County	529,000	577,900	622,600	664,400	748,200	774,100
Albuquerque	422,200	461,200	497,000	530,300	597,200	617,800
Sandoval County	72,900	79,600	85,800	91,500	103,100	106,600
Valencia County	51,200	55,900	60,200	64,300	72,400	74,900

Total ROI	653,100	713,400	768,600	820,200	923,700	955,600
City values are included in county totals. Census 1993a; Census 1993m; DOC 1990c; DOC 1990d; DOC 1994j.						

Table D.2.1-16.--Population for the Nevada Test Site Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030
Clark County	941,100	1,084,100	1,181,200	1,250,500	1,392,900	1,441,100
Henderson	93,900	108,100	117,800	124,800	139,000	143,800
Las Vegas	328,900	378,800	412,800	437,000	486,800	503,600
North Las Vegas	61,800	71,200	77,600	82,200	91,500	94,700
Nye County	21,700	25,000	27,300	28,900	32,100	33,300
Total ROI	962,800	1,109,100	1,208,500	1,279,400	1,425,000	1,474,400
City values are included in county totals. Census 1993a; Census 1993y; DOC 1990c; DOC 1990d; DOC 1994j.						

D.2.2 Housing

No action housing characteristics are presented in tables D.2.2-1 through D.2.2-8. Projected housing needs are based upon housing unit and population data obtained from the 1990 Census of Population and Housing for each ROI. Future housing units needed for cities and counties in each ROI were developed by estimating the household size from the current population and housing unit ratios. The household size to population ratios were then applied to the estimated future population trends to obtain the number of housing units needed to accommodate the projected population for a No Action alternative future baseline.

Projected housing needs for the proposed alternatives were derived by a similar method, but a national average population-to-housing ratio was used. The additional housing needed for the estimated in-migrating workforce and their families are calculated after vacancy rates for the affected region are reduced to the lowest historical level. Past housing construction trends are also evaluated to assess potential impacts.

Table D.2.2-1.-- Owner and Renter Housing Units for the Oak Ridge Reservation Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030
Anderson County	30,500	32,200	33,600	34,900	37,300	37,700
Clinton	4,300	4,600	4,700	4,900	5,300	5,300
Oak Ridge	11,000	11,600	12,100	12,600	13,500	13,600
Knox County	150,400	158,800	165,600	171,700	183,600	185,900
Knoxville	78,000	82,400	86,000	89,100	95,300	96,500

Loudon County	13,900	14,600	15,300	15,800	16,900	17,100
Lenoir City	3,100	3,200	3,400	3,500	3,700	3,800
Roane County	20,300	21,400	22,300	23,100	24,700	25,000
Harriman	3,200	3,400	3,500	3,700	3,900	4,000
Kingston	2,100	2,300	2,400	2,500	2,600	2,700
Total ROI	215,100	227,000	236,800	245,500	262,500	265,700
City values are included in county totals. Census 1991c; appendix table D.2.1-9.						

Table D.2.2-2.--Owner and Renter Housing Units for the Savannah River Site Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030
Aiken County	52,600	56,000	58,800	61,600	67,500	68,100
Aiken	9,800	10,400	10,900	11,400	12,500	12,600

North Augusta	7,500	8,000	8,400	8,800	9,600	9,700
Barnwell County	8,100	8,600	9,000	9,500	10,400	10,500
Columbia County	26,400	28,000	29,500	30,900	33,800	34,100
Richmond County	81,800	87,000	91,500	95,800	105,000	105,900
Augusta	21,100	22,400	23,600	24,700	27,000	27,300
Total ROI	168,900	179,600	188,800	197,800	216,700	218,600

City values are included in county totals.

Census 1991a; Census 1991b; appendix table D.2.1-10.

Table D.2.2-3.-- Owner and Renter Housing Units for the Kansas City Plant Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030
Cass County	25,500	26,400	27,200	28,100	30,000	30,300
Belton	7,300	7,500	7,800	8,000	8,500	8,600

Harrisonville	4,200	4,300	4,400	4,600	4,900	4,900
Jackson County	276,300	285,500	294,600	304,300	324,600	328,200
Kansas City	195,600	202,000	208,500	215,400	229,700	232,300
Lee's Summit	38,200	39,400	40,700	42,000	44,800	45,300
Johnson County	153,100	158,100	163,200	168,600	179,800	181,800
Overland Park	51,400	53,100	54,800	56,600	60,300	61,000
Wyandotte County	66,800	69,000	71,200	73,600	78,500	79,400
Total ROI	521,700	539,000	556,200	574,600	612,900	619,700

City values are included in county totals.

Census 1991f; Census 1991ff; appendix table D.2.1-11.

Table D.2.2-4.-- Owner and Renter Housing Units for the Pantex Plant Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030
Armstrong County	800	900	900	1,000	1,100	1,100

Carson County	2,700	2,800	3,000	3,200	3,500	3,500
Potter County	44,000	46,400	48,900	51,500	56,600	56,600
Amarillo	71,300	75,200	79,300	83,400	91,800	91,700
Randall County	39,600	41,800	44,000	46,300	51,000	50,900
Total ROI	87,100	91,900	96,800	102,000	112,200	112,100

Amarillo is divided across Potter and Randall Counties. The number of housing units shown for Amarillo is for the whole city. Potter and Randall County totals represent their share of Amarillo.

Census 1991m; appendix table D.2.1-12.

Table D.2.2-5.-- Owner and Renter Housing Units for the Los Alamos National Laboratory Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030
Los Alamos County	8,000	8,800	9,500	10,100	11,400	11,800
Rio Arriba County	15,400	16,900	18,200	19,400	21,800	22,600
Espanola	1,000	1,100	1,200	1,300	1,500	1,500

Santa Fe County	46,700	51,000	54,900	58,600	66,000	68,300
Santa Fe	27,600	30,100	32,500	34,700	39,000	40,400
Total ROI	70,100	76,700	82,600	88,100	99,200	102,700

City values are included in county totals.

Census 1991h; appendix table D.2.1-13.

Table D.2.2-6.-- Owner and Renter Housing Units for the Lawrence Livermore National Laboratory Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030
Alameda County	543,300	596,100	649,000	704,900	832,900	845,400
Livermore	24,200	26,500	28,900	31,400	37,100	37,600
Pleasanton	22,100	24,200	26,400	28,700	33,900	34,400
Contra Costa County	347,800	381,600	415,500	451,300	533,200	541,200
San Joaquin County	183,100	200,900	218,700	237,600	280,700	284,900
Manteca	10,400	11,400	12,400	13,500	16,000	16,200

Tracy	14,900	16,300	17,800	19,300	22,800	23,200
Total ROI	1,074,200	1,178,600	1,283,200	1,393,800	1,646,800	1,671,500

City values are included in county totals.

Census 1991j; appendix table D.2.1-14.

Table D.2.2-7.-- Owner and Renter Housing Units for the Sandia National Laboratories Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030
Bernalillo County	221,500	242,000	260,700	278,200	313,300	324,100
Albuquerque	183,100	200,000	215,500	230,000	259,000	268,000
Sandoval County	27,200	29,800	32,100	34,200	38,500	39,900
Valencia County	19,000	20,700	22,300	23,800	26,900	27,800
Total ROI	267,700	292,500	315,100	336,200	378,700	391,800

City values are included in county totals.

Census 1991h; appendix table D.2.1-15.

Table D.2.2-8.-- Owner and Renter Housing Units for the Nevada Test Site Region of Influence, No Action Alternative, 1995-2030

County/City	1995	2000	2005	2010	2020	2030
Clark County	383,700	442,000	481,600	509,800	567,900	587,500
Henderson	35,700	41,100	44,800	47,500	52,900	54,700
Las Vegas	136,400	157,100	171,200	181,200	201,800	208,800
North Las Vegas	19,900	22,900	25,000	26,400	29,400	30,500
Nye County	8,600	9,900	10,800	11,400	12,800	13,200
Total ROI	392,300	451,900	492,400	521,200	580,700	600,700

City values are included in county totals.

Census 1991g; appendix table D.2.1-16.

D.2.3 Public Finance

Finances of ROI local jurisdictions were evaluated based on changes in historic revenue and expenditure levels, changes in fund balances, and reserve bonding capabilities. These historic fiscal characteristics were obtained from financial audits and budgets supplied by each jurisdiction. The analysis concentrated on each jurisdiction's governmental funds (general funds, special revenue funds, and, as applicable, capital projects, debt service, and expendable trust funds). Other funds, such as enterprise funds, which are funded principally through user charges without contributing to the general tax burden of area residents, were not included in the analysis. The analysis of local jurisdictions' public finances focused upon revenues and expenditures because no assumptions could be made for some projected fund balances (such as capital expenditures) so far into the future.

The following parameters were used to project changes in total revenues and expenditures: gains (or losses) of jobs in the region; population increases (or decreases) in each jurisdiction, including school districts; earnings and income gains (or losses); and potential changes in each jurisdiction's property tax base. Public finance and No Action characteristics are presented in tables D.2.3-1 through D.2.3-15.

Table D.2.3-1.-- County and City Revenues and Expenditures for the Oak Ridge Reservati

Revenues and Expenditures	Anderson County	Clinton	Oak Ridge	Knox County	Knoxville	Loudon County	Lenoir City
Property tax (percent)	40	62	22	54	73	37	30
State shared and intergovernmental (percent)	48	27	69	36	20	52	61
Permits, fees, fines, and investment interest (percent)	12	2	5	2	5	8	6
Other (percent)	0	9	4	8	2	3	3
Total Revenues (dollars)	50,802,902	5,320,132	41,367,745	358,355,159	118,642,146	25,630,923	10,820,6
General government (percent)	23	26	2	23	6	20	8
Public safety, health, and community services (percent)	0	19	11	0	39	0	9

Public works, parks, culture, and recreation (percent)	5	26	14	2	30	8	10
Debt services (percent)	0	15	5	6	16	11	5
Education (percent)	51	0	62	60	5	57	67
Capital outlay (percent)	21	14	6	9	4	4	1
Other (percent)	0	0	0	0	0	0	0
Total Expenditures (dollars)	58,487,767	5,768,608	45,633,111	374,478,124	103,877,538	27,201,056	10,581,4:
End-of-Year Fund Balance (dollars)	16,460,005	4,015,490	18,299,359	50,735,073	32,350,878	4,533,445	2,122,27(
Financial information for ORR school districts is included in county and city financial audits. OR City 1995b; OR County 1995a.							

Table D.2.3-2.-- County and City Revenues and Expenditures for the Savannah River Site Region of Influence, 1994

Revenues and Expenditures	Aiken County, SC	Aiken	North Augusta	Barnwell County, SC	Columbia County, GA	Richmond County, GA	Augusta
Property tax (percent)	53	40	45	24	70	79	59
State shared and intergovernmental (percent)	31	7	10	74	4	0	20
Permits, fees, fines, and investment interest (percent)	7	49	41	0	12	14	9

Other (percent)	9	4	4	2	14	7	12
Total Revenues (dollars)	35,159,759	14,240,252	6,615,993	7,429,225	32,547,657	87,277,685	33,975,011
General government (percent)	10	7	17	40	9	11	20
Public safety, health, and community services (percent)	34	28	38	34	36	44	28
Public works, parks, culture, and recreation (percent)	20	27	32	20	22	18	18
Debt services (percent)	11	2	5	0	2	10	7
Education (percent)	5	0	0	0	0	0	0
Capital outlay (percent)	14	20	8	0	21	17	19
Other (percent)	6	16	0	6	10	0	8
Total Expenditures (dollars)	35,790,029	14,322,339	6,810,049	5,146,577	34,607,926	81,414,049	48,712,791
End-of-Year Fund Balance (dollars)	16,594,477	11,204,482	2,609,106	8,274,191	11,649,564	77,244,431	11,725,730

SR City 1995a; SR County 1995a.

Table D.2.3-3.-- School District Revenues and Expenditures for the Savannah River Site Region of Influence, 1994

Revenues and Expenditures	Aiken County, SC	Barnwell County #19, SC	Barnwell County #29, SC	Barnwell County #45, SC	Columbia County, GA	Richmond County, GA
Local sources (percent)	39	21	34	33	36	35
State sources (percent)	55	69	58	58	60	54
Federal sources (percent)	6	10	8	9	4	11
Other (percent)	0	0	0	0	0	0
Total Revenues (dollars)	101,336,443	5,453,008	4,627,943	11,409,161	67,786,080	162,652,868
Total instruction (percent)	52	57	39	60	57	59
Support services (percent)	27	39	24	28	26	30
Food, community, and other services (percent)	2	2	1	1	6	7

Capital assets (percent)	10	0	32	0	5	1
Debt services (percent)	9	2	4	11	6	3
Total Expenditures (dollars)	113,866,054	5,413,238	6,981,754	11,343,781	70,300,960	157,087,533
End-of-Year Fund Balance (dollars)	15,139,008	764,024	671,935	1,866,666	33,103,796	33,919,859
SR School 1995b.						

Table D.2.3-4.-- County and City Revenues and Expenditures for the Kansas City Plant Reg

Revenues and Expenditures	Cass County	Belton	Harrisonville	Jackson County	Kansas City	Lee's Summit	Johnsoı County
Property tax (percent)	NA	63	63	74	56	67	54
State shared and intergovernmental (percent)	NA	8	1	10	9	18	19
Permits, fees, fines, and investment interest (percent)	NA	10	31	13	28	11	19
Other (percent)	NA	19	5	3	7	4	8
Total Revenues (dollars)	NA	7,081,222	4,070,287	109,755,131	480,601,000	25,369,494	162,258,4
General government (percent)	NA	11	17	54	6	9	19
Public safety, health, and community services (percent)	NA	44	51	29	24	41	39

Public works, parks, culture, and recreation (percent)	NA	22	28	15	33	22	16
Debt services (percent)	NA	15	2	2	11	12	8
Capital outlay (percent)	NA	8	0	0	11	16	18
Other (percent)	NA	0	2	0	15	0	0
Total Expenditures (dollars)	NA	6,498,171	3,385,267	109,901,97	459,477,00	23,522,269	157,076,2
End-of-Year Fund Balance (dollars)	NA	3,637,533	4,301,121	60,948,809	276,086,000	20,044,897	77,735,98

NA - not available.
KC City 1995a; KC County 1995a.

Table D.2.3-5.-- School District Revenues and Expenditures for the Kansas City Plant Region of Influence, 1994

Revenues and Expenditures	Belton	Center	Harrisonville	Hickman Hills	Kansas City	Lee's Summit	Unified School District #229
Local sources (percent)	49	81	55	59	40	NA	65
State sources (percent)	45	15	36	36	53	NA	28
Federal sources (percent)	6	4	5	4	7	NA	1
Other (percent)	0	0	4	1	0	NA	6

Total Revenues (dollars)	18,578,226	16,923,736	11,735,893	38,744,073	371,171,282	NA	80,571,877
Total instruction (percent)	59	57	53	62	41	NA	50
Support services (percent)	26	37	32	25	35	NA	24
Food, community, and other services (percent)	10	1	5	9	11	NA	4
Capital assets (percent)	0	4	2	1	7	NA	9
Debt services (percent)	5	1	8	3	6	NA	13
Total Expenditures (dollars)	17,802,120	17,134,971	11,425,842	40,641,975	368,956,267	NA	80,034,572
End-of-Year Fund Balance (dollars)	5,261,823	6,094,505	3,268,301	9,066,453	217,966,000	NA	67,979,753

NA - not available.

KC School 1995a.

Table D.2.3-6.-- County and City Revenues and Expenditures for the Pantex Plant Region of Influence, 1994

Revenues and Expenditures	Armstrong County	Carson County	Potter County	Amarillo	Randall County

Property tax (percent)	34	65	66	59	55
State shared and intergovernmental (percent)	17	2	9	11	13
Permits, fees, fines, and investment interest (percent)	46	26	20	18	30
Other (percent)	3	7	5	12	2
Total Revenues (dollars)	749,995	1,829,229	21,516,628	76,603,713	13,065,681
General government (percent)	31	46	15	7	18
Public safety, health, and community services (percent)	32	35	57	38	59
Public works, parks, culture, and recreation (percent)	30	5	11	45	4
Debt services (percent)	4	0	7	2	4
Capital outlay (percent)	3	9	5	8	5
Other (percent)	0	5	5	0	10

Total Expenditures (dollars)	746,983	2,585,350	19,633,506	69,837,313	11,968,123
End-of-Year Fund Balance (dollars)	593,463	18,239	20,960,491	52,263,778	5,011,059
PX City 1995a; PX County 1995a.					

Table D.2.3-7.-- School District Revenues and Expenditures for the Pantex Plant Region of Influence, 1994

Revenues and Expenditures	Amarillo	Canyon	Claude	Groom	Highland Park	Panhandle	White Deer
Local sources (percent)	43	48	42	55	89	82	92
State sources (percent)	49	47	54	40	6	14	4
Federal sources (percent)	8	5	4	5	5	4	4
Other (percent)	0	0	0	0	0	0	0
Total Revenues (dollars)	129,782,359	27,248,718	2,196,573	1341,890	3,932,722	4,388,125	2,684,692
Total instruction (percent)	58	49	56	55	55	58	57
Support services (percent)	26	20	30	26	26	31	35

Food, community, and other services (percent)	6	6	10	18	17	7	8
Capital assets (percent)	4	16	3	1	0	0	0
Debt (percent)	6	9	1	0	2	4	0
Total Expenditures (dollars)	128,143,906	31,082,492	2,128,995	1,334,653	3,952,534	4,091,362	2,763,782
End-of-Year Fund Balance (dollars)	31,696,194	11,461,816	688,758	635,061	887,714	1,853,969	745,117

1993 and 1994 financial audit data is not available for Groom and Highland Park School District. Data presented is for 1992.
PX School 1995b.

Table D.2.3-8.-- County and City Revenues and Expenditures for the Los Alamos National Laboratory Region of Influence, 1994

Revenues and Expenditures	Los Alamos County	Rio Arriba County	Espanola	Santa Fe County	Santa Fe
Property tax (percent)	32	74	11	72	83
State shared and intergovernmental (percent)	61	20	89	12	8
Permits, fees, fines, and investment interest (percent)	1	2	0	6	3

Other (percent)	6	4	0	10	6
Total Revenues (dollars)	29,717,452	10,662,842	6,679,263	29,528,335	65,044,193
General government (percent)	16	36	24	25	18
Public safety, health, and community services (percent)	38	36	37	45	30
Public works, parks, culture, and recreation (percent)	23	23	20	20	16
Debt services (percent)	3	4	12	1	11
Education (percent)	0	0	0	0	3
Capital outlay (percent)	20	1	7	8	22
Other (percent)	0	0	0	1	0
Total Expenditures (dollars)	30,986,489	9,280,844	7,015,513	27,221,324	62,458,448
End-of-Year Fund Balance (dollars)	27,443,804	5,570,366	2,851,826	17,676,743	61,911,387

LA City 1995a; LA County 1995a.

Table D.2.3-9.-- School District Revenues and Expenditures for the Los Alamos National Laboratory Region of Influence, 1994

Revenues and Expenditures	Chama Valley	Dulce	Espanola	Jemez Mountain	Los Alamos	Pojaque Valley	Santa Fe
Local sources (percent)	12	31	6	38	6	8	21
State sources (percent)	77	40	70	50	52	69	71
Federal sources (percent)	10	28	22	11	34	13	6
Other (percent)	1	1	2	1	8	10	2
Total Revenues (dollars)	3,851,965	5,418,941	25,907,153	5,250,028	23,091,825	11,605,168	59,555,031
Total instruction (percent)	43	45	62	35	53	37	41
Support services (percent)	37	36	29	30	39	28	23
Food, community, and other services (percent)	12	5	1	15	6	11	7
Capital assets (percent)	3	6	4	0	2	19	18

Debt services (percent)	5	8	4	20	0	5	11
Total Expenditures (dollars)	3,886,197	4,535,793	25,790,674	4,034,170	21,561,064	10,673,138	66,958,009
End-of-Year Fund Balance (dollars)	824,466	1,960,709	2,729,798	2,061,502	4,511,190	1,958,054	10,345,713
LA School 1995b.							

Table D.2.3-10.-- County and City Revenues and Expenditures for the Lawrence Livermore Na Laboratory Region of Influence, 1994

Revenues and Expenditures	Alameda County	Livermore	Pleasanton	Contra Costa County	San Joaquin County	Manteca	T
Property tax (percent)	27	52	59	22	15	51	32
State shared and intergovernmental (percent)	54	12	0	57	67	24	16
Permits, fees, fines, and investment interest (percent)	14	17	5	16	16	20	36
Other (percent)	5	19	36	5	2	5	16
Total Revenues (dollars)	1,111,718,000	39,977,156	44,664,303	792,483,000	505,566,121	17,848,109	32,9

General government (percent)	6	7	15	9	10	12	7
Public safety, health, and community services (percent)	90	26	32	65	66	44	22
Public works, parks, culture, and recreation (percent)	2	9	23	20	19	25	28
Debt services (percent)	1	10	8	3	4	9	3
Capital outlay (percent)	1	35	21	2	1	2	40
Other (percent)	0	13	1	1	0	8	0
Total Expenditures (dollars)	1,150,106,000	58,087,750	45,191,452	777,803,000	522,340,513	16,405,126	33,7
End-of-Year Fund Balance (dollars)	362,808,000	34,291,803	38,104,992	161,995,000	106,530,027	16,254,955	52,4
1993 and 1994 financial audit data are not available for Alameda County. Data presented is for 1992. LL City 1995a; LL County 1995a.							

Table D.2.3-11.-- School District Revenues and Expenditures for the Lawrence Livermore National Laboratory Region of Influence, 1994

Revenues and Expenditures	Livermore	Manteca	Pleasanton	Tracy

Local sources (percent)	25	NA	43	54
State sources (percent)	18	NA	2	3
Federal sources (percent)	4	NA	16	21
Other (percent)	53	NA	39	22
Total Revenues (dollars)	45,153,012	NA	41,647,514	10,492,709
Total instruction (percent)	61	NA	64	67
Support services (percent)	10	NA	9	10
Food, community, and other services (percent)	15	NA	6	6
Capital assets (percent)	12	NA	13	14
Debt services (percent)	2	NA	8	3
Total Expenditures (dollars)	61,710,651	NA	62,763,588	17,080,415

End-of-Year Fund Balance (dollars)	20,793,153	NA	47,224,057	2,989,001
NA - not available. LL School 1995b.				

Table D.2.3-12.-- County and City Revenues and Expenditures for the Sandia National Laboratories Region of Influence, 1994

Revenues and Expenditures	Bernalillo County	Albuquerque	Sandoval County	Valencia County
Property tax (percent)	55	39	28	53
State shared and intergovernmental (percent)	34	42	40	22
Permits, fees, fines, and investment interest (percent)	5	12	23	8
Other (percent)	6	7	9	17
Total Revenues (dollars)	93,822,427	385,722,000	16,098,094	8,637,085
General government (percent)	33	10	21	47
Public safety, health, and community services (percent)	31	38	51	39

Public works, parks, culture, and recreation (percent)	11	18	21	14
Debt services (percent)	9	15	3	0
Education (percent)	0	0	0	0
Capital outlay (percent)	16	19	4	0
Other (percent)	0	0	0	0
Total Expenditures (dollars)	104,033,393	402,203,000	15,833,145	7,891,026
End-of-Year Fund Balance (dollars)	100,227,840	165,534,000	8,984,259	3,858,325
SN City 1995a; SN County 1995a.				

Table D.2.3-13.-- School District Revenues and Expenditures for the Sandia National Laboratories Region of Influence, 1994

Revenues and Expenditures	Albuquerque	Belen	Bernalillo	Cuba	Jemez Valley	Los Lunas
Local sources (percent)	15	12	9	7	10	9

State sources (percent)	77	78	68	68	84	82
Federal sources (percent)	8	10	22	23	6	9
Other (percent)	0	0	1	2	0	0
Total Revenues (dollars)	440,575,033	20,666,616	18,255,208	5,607,902	15,271,490	29,715,373
Total instruction (percent)	70	60	44	35	27	55
Support services (percent)	11	19	30	39	18	15
Food, community, and other services (percent)	7	11	9	17	7	10
Capital assets (percent)	9	4	12	6	10	15
Debt services (percent)	3	6	5	3	38	5
Total Expenditures (dollars)	431,378,717	21,036,713	19,110,291	5,585,793	15,989,616	30,399,901
End-of-Year Fund Balance (dollars)	65,734,673	6,535,537	1,507,421	350,155	727,740	6,925,651

SN School 1995b.

Table D.2.3-14.-- County and City Revenues and Expenditures for the Nevada Test Site Region of Influence, 1994

Revenues and Expenditures	Clark County	Henderson	Las Vegas	North Las Vegas	Nye County
Property tax (percent)	20	16	16	15	28
State shared and intergovernmental (percent)	42	47	54	54	54
Permits, fees, fines, and investment interest (percent)	30	12	19	25	8
Other (percent)	8	25	11	6	10
Total Revenues (dollars)	728,952,912	70,207,217	254,132,758	52,451,349	26,331,990
General government (percent)	19	11	16	11	29
Public safety, health, and community services (percent)	39	25	40	52	37
Public works, parks, culture, and recreation (percent)	8	10	16	15	18
Debt services (percent)	8	13	4	5	0

Capital outlay (percent)	22	41	24	17	16
Other (percent)	4	0	0	0	0
Total Expenditures (dollars)	768,785,508	90,878,941	257,883,768	54,111,779	26,150,708
End-of-Year Fund Balance (dollars)	809,371,503	131,125,991	165,467,135	13,390,894	16,984,705
1994 financial audit for Clark County was not available. Data presented are for 1993. NT City 1995a; NT County 1995b.					

Table D.2.3-15.-- School District Revenues and Expenditures for the Nevada Test Site Region of Influence, 1994

Revenues and Expenditures	Clark County	Nye County
Local sources (percent)	65	53
State sources (percent)	32	44
Federal sources (percent)	3	3
Other (percent)	0	0

Total Revenues (dollars)	716,416,150	24,079,470
Total instruction (percent)	54	48
Support services (percent)	28	21
Food, community, and other services (percent)	0	6
Capital assets (percent)	11	9
Debt services (percent)	7	16
Total Expenditures (dollars)	776,079,680	25,176,765
End-of-Year Fund Balance (dollars)	82,578,235	5,060,909
NT School 1995b.		

D.2.4 Environmental Justice in Minority and Low-Income Populations

DOE is committed, and required by law, to incorporate environmental justice principles into its operations. Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations* , requires Federal agencies to identify and address appropriately disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. DOE is in the process of finalizing its Environmental Justice Strategy and issued its first document in April 1995, which provides a structured framework. This strategy will be finalized once stakeholders' comments, concerns, and opinions are received, reviewed, and incorporated as appropriate. Because DOE is still in the process of developing guidance, the approach taken in this analysis may depart somewhat from the guidance that is eventually issued.

Any disproportionately high and adverse human health effects on minority populations and low-income populations that could result from the alternatives being considered are assessed for an 80 km (50 mi) area surrounding each site. The shaded areas in figures D.2.4-1 through D.2.4-8 show Census tracts where racial or ethnic minorities comprise 50 percent or more (simple majority) of the total population, and where racial or ethnic minorities comprise less than 50 but greater than 25 percent of the total population in the Census tract.
[figure D.2.4-2]
[figure D.2.4-3]
[figure D.2.4-4]
[figure D.2.4-5]
[figure D.2.4-6, page 1 of 5]
[figure D.2.4-6, page 2 of 5]
[figure D.2.4-6, page 3 of 5]
[figure D.2.4-6, page 4 of 5]
[figure D.2.4-6, page 5 of 5]
[figure D.2.4-7]
Figures D.2.4-9 through D.2.4-16 show low income communities generally defined as those where 25 percent or more of the population is characterized as living in poverty (income of less than $8,076 for a family of two).
[figure D.2.4-10]
[figure D.2.4-11]
[figure D.2.4-12]
[figure D.2.4-13]
[figure D.2.4-14, page 1 of 5]
[figure D.2.4-14, page 2 of 5]
[figure D.2.4-14, page 3 of 5]
[figure D.2.4-14, page 4 of 5]
[figure D.2.4-14, page 5 of 5]
[figure D.2.4-15] Socioeconomic impacts are assessed for the ROI of each site, since the impacts result from economic linkages rather than geographic proximity. Selected demographic characteristics of the ROI for each of the seven candidates sites are presented in tables D.2.4-1 through D.2.4-8. An assessment of any potential disproportionately high and adverse human health or environmental effects on minority and low-income populations that could result from the alternatives being considered is presented in chapter 4.

Table D.2.4-1.-- Selected Demographic Characteristics for the Oak Ridge Reservation Region of Influence

					Total Region of Influence	
Characteristic/Area	**Anderson County (number)**	**Knox County (number)**	**Loudon County (number)**	**Roane County (number)**	**(number)**	**(percent)**
Persons by Race/Ethnicity						
Non-Hispanic, White	64,320	300,040	30,668	45,274	440,302	91.3
Hispanic	381	2,067	83	212	2,743	0.6
Non-Hispanic, American Indian	236	775	52	95	1,158	0.2
Non-Hispanic, Black	2,753	29,483	400	1,456	34,092	7.1
Non-Hispanic, Asian/Pacific Islander	537	3,263	49	186	4,035	0.8
Non-Hispanic, Other	23	121	3	4	151	0.0
Total 1990 Population	68,250	335,749	31,255	47,227	482,481	

Total Number of Households	27,384	133,639	12,155	18,453	191,631	
1989 Low Income						
Persons Below Poverty						
Number	9,664	45,608	4,192	7,467	66,931	
Percent1	14.3	14.1	13.6	16.0	14.3	

Table D.2.4-2.-- Selected Demographic Characteristics for the Savannah River Site Region of Influence

	South Carolina		Georgia		Total Region of Influence	
Characteristic/Area	**Aiken County (number)**	**Barnwell County (number)**	**Columbia County (number)**	**Richmond County (number)**	**(number)**	**(percent)**
Persons by Race/Ethnicity						
Non-Hispanic, White	90,130	11,421	56,141	103,009	270,727	63.6
Hispanic	867	146	962	3,707	5,918	1.4
Non-Hispanic, American Indian	213	31	150	491	918	0.2
Non-Hispanic, Black	29,176	8,677	7,239	79,221	142,608	33.5

Non-Hispanic, Asian/Pacific Islander	528	17	1,518	3,186	5,276	1.2
Non-Hispanic, Other	26	1	21	105	160	0.0
Total 1990 Population	120,940	20,293	66,031	189,719	425,607	99.9
Total Number of Households	44,883	7,100	21,841	68,675	151,877	
1989 Low Income						
Persons Below Poverty						
Number	16,671	4,367	4,255	32,590	66,267	
Percent1	14.0	21.8	6.6	18.2	17.3	

Table D.2.4-3.--Selected Demographic Characteristics for the Kansas City Plant Region of Influence

	Missouri		**Kansas**		**Total Region of Influence**	
Characteristic/Area	**Cass County (number)**	**Jackson County (number)**	**Johnson County (number)**	**Wyandotte County (number)**	**(number)**	**(percent)**
Persons by Race/Ethnicity						
Non-Hispanic, White	61,689	470,011	334,167	103,955	969,822	79.9

Hispanic	829	18,890	7,005	10,997	37,721	3.1
Non-Hispanic, American Indian	355	2,825	160	966	4,306	0.4
Non-Hispanic, Black	672	134,828	6,809	44,131	186,440	15.4
Non-Hispanic, Asian/Pacific Islander	251	6,145	5,739	787	12,922	1.1
Non-Hispanic, Other	12	533	174	157	876	0.1
Total 1990 Population	63,808	633,232	355,054	161,993	1,214,087	100
Total Number of Households	22,892	252,852	136,433	61,514	473,691	
1989 Low Income						
Persons Below Poverty						
Number	5,164	81,142	12,667	27,371	126,344	
Percent1	8.2	13.0	3.6	17.1	10.5	

Table D.2.4-4.-- Selected Demographic Characteristics for the Pantex Plant Region of Influence

Characteristic/Area	Armstrong County (number)	Carson County (number)	Potter County (number)	Randall County (number)	Total Region of Influence (number)	Total Region of Influence (percent)
Persons by Race/Ethnicity						
Non-Hispanic, White	1,951	6,158	66,877	81,364	156,350	79.7
Hispanic	55	354	19,246	6,144	25,799	13.1
Non-Hispanic, American Indian	9	41	709	414	1,173	0.6
Non-Hispanic, Black	0	11	8,460	1,082	9,553	4.9
Non-Hispanic, Asian/Pacific Islander	5	9	2,431	626	3,071	1.6
Non-Hispanic, Other	1	3	151	43	198	0.1
Total 1990 Population	2,021	6,576	97,874	89,673	196,144	100.0

Total Number of Households	768	2,402	37,344	34,553	75,067	
1989 Low Income						
Persons Below Poverty						
Number	232	583	21,619	7,819	30,253	
Percent1	11.8	9.0	22.5	8.9	15.7	

Table D.2.4-5.-- Selected Demographic Characteristics for the Los Alamos National Laboratory Region of Influence

				Total Region of Influence	
Characteristic/Area	**Los Alamos County (number)**	**Rio Arriba County (number)**	**Santa Fe County (number)**	**(number)**	**(percent)**
Persons by Race/Ethnicity					
Non-Hispanic, White	15,467	4,375	46,450	66,292	43.8
Hispanic	2,008	24,955	48,939	75,902	50.1
Non-Hispanic, American Indian	112	4,830	2,284	7,226	4.8
Non-Hispanic, Black	88	117	505	710	0.5

Non-Hispanic, Asian/Pacific Islander	421	40	439	900	0.6
Non-Hispanic, Other	19	48	311	378	0.2
Total 1990 Population	18,115	34,365	98,928	151,408	100
Total Number of Households	7,213	11,461	37,840	56,514	
1989 Low Income					
Persons Below Poverty					
Number	433	9,372	12,564	22,369	
Percent1	2.4	27.5	13	15.0	

Table D.2.4-6.-- Selected Demographic Characteristics for the Lawrence Livermore National Laboratory Region of Influence

				Total Region of Influence	
Characteristic/Area	**Alameda County (number)**	**Contra Costa County (number)**	**San Joaquin County (number)**	**(number)**	**(percent)**
Persons by Race/Ethnicity					

Non-Hispanic, White	680,017	560,146	282,766	1,522,929	59.4
Hispanic	181,805	91,282	112,673	385,760	15
Non-Hispanic, American Indian	6,763	4,441	3,807	15,011	0.6
Non-Hispanic, Black	222,873	72,799	24,791	320,463	12.5
Non-Hispanic, Asian/Pacific Islander	184,813	73,810	55,774	314,397	12.3
Non-Hispanic, Other	2,911	1,254	817	4,982	0.2
Total 1990 Population	1,279,182	803,732	480,628	2,563,542	100
Total Number of Households	479,518	300,288	158,156	937,962	
1989 Low Income					
Persons Below Poverty					
Number	132,011	57,867	73,163	263,041	
Percent1	10.6	7.3	15.7	10.5	

Table D.2.4-7.--Selected Demographic Characteristics for the Sandia National Laboratories Region of Influence

				Total Region of Influence	
Characteristic/Area	**Bernalillo County (number)**	**Sandoval County (number)**	**Valencia County (number)**	**(number)**	**(percent)**
Persons by Race/Ethnicity					
Non-Hispanic, White	267,965	32,390	20,659	321,014	54.5
Hispanic	178,310	17,372	22,733	218,415	37.1
Non-Hispanic, American Indian	14,191	12,176	1,169	27,536	4.7
Non-Hispanic, Black	11,862	844	448	13,154	2.2
Non-Hispanic, Asian/Pacific Islander	6,692	455	139	7,286	1.2
Non-Hispanic, Other	1,557	82	87	1,726	0.3
Total 1990 Population	480,577	63,319	45,235	589,131	100
Total Number of Households	185,582	20,867	15,170	221,619	

1989 Low Income					
Persons Below Poverty					
Number	68,845	9,852	8,288	86,985	
Percent1	14.6	15.6	19	15.0	

Table D.2.4-8.--Selected Demographic Characteristics for the Nevada Test Site Region of Influence

			Total Region of Influence	
Characteristic/Area	**Clark County (number)**	**Nye County (number)**	**(number)**	**(percent)**
Persons by Race/Ethnicity				
Non-Hispanic, White	558,875	15,635	574,510	75.7
Hispanic	82,904	1,237	84,141	11.1
Non-Hispanic, American Indian	5,514	475	5,989	0.8
Non-Hispanic, Black	68,858	274	69,132	9.1
Non-Hispanic, Asian/Pacific Islander	24,483	148	24,631	3.2

Non-Hispanic, Other	825	12	837	0.1
Total 1990 Population	741,459	17,781	759,240	100.0
Total Number of Households	287,025	6,664	293,689	
1989 Low Income				
Persons Below Poverty				
Number	76,737	1,840	78,577	
Percent1	10.5	10.5	10.5	

1

In calculating percentages, certain categories of individuals are not included as part of the county population including: inmates of institutions, armed forces members, and unrelated individuals under 15 years of age.

Census 1993s; Census 1994o.

APPENDIX E: HUMAN HEALTH

E.1 Introduction

Supplemental information is presented in this appendix on the potential impacts to humans from the normal operational releases of radioactivity and hazardous chemicals from the Stockpile Stewardship and Management Program facilities. This information is intended to support assessments of normal operation for the management and stewardship facilities described in sections 4.2.3.9, 4.3.3.9, 4.4.3.9, 4.5.3.9, 4.6.3.9, 4.7.3.9, 4.8.3.9, and 4.9.3.9 of this programmatic environmental impact statement (PEIS). Section E.2 provides information on radiological impacts while section E.3 provides information on hazardous chemical impacts.

E.2 Radiological Impacts to Human Health

Section E.2 presents supporting information on the potential radiological impacts to humans during normal operation of the PEIS alternatives. This section provides the reader with background information on the nature of radiation (section E.2.1), the methodology used to calculate radiological impacts (section E.2.2), and radiological releases from stockpile management facilities (section E.2.3). Releases associated with the No Action alternative for each site can be found in the referenced site environmental reports.

E.2.1 Background

E.2.1.1 Nature of Radiation and Its Effects on Humans

What is Radiation? Humans are constantly exposed to radiation from the solar system and from the earth's rocks and soil. This radiation contributes to the natural background radiation that has always surrounded us. But there are also manmade sources of radiation, such as medical and dental x rays, household smoke detectors, and materials released from nuclear and coal-fired powerplants.

All matter in the universe is composed of atoms, and radiation comes from the activity of these tiny particles. Atoms are made up of even smaller particles (protons, neutrons, and electrons). The number and arrangement of these particles distinguishes one atom from another.

Atoms of different types are known as elements. There are over 100 natural and manmade elements. Some of these elements, such as uranium, radium, plutonium, and thorium, share a very important quality: they are unstable. As they change into more stable forms, invisible waves of energy or particles, known as ionizing radiation, are released. Radioactivity is the emitting of this radiation.

Ionizing radiation refers to the fact that this energy force can ionize, or electrically charge atoms by stripping off electrons. Ionizing radiation can cause a change in the chemical composition of many things, including living tissue (organs), which can affect the way they function.

The effects on people of radiation that is emitted during disintegration (decay) of a radioactive substance depends on the kind of radiation (alpha and beta particles and gamma and x rays) and the total amount of radiation energy absorbed by the body. Alpha particles are the heaviest of these direct types of ionizing radiation, and despite a speed of about 16,100 kilometers (km) per second(s) (kps)

(10,000 miles [mi] per second [mps]), they can travel only a few inches in the air. Alpha particles lose their energy almost as soon as they collide with anything. They can easily be stopped by a sheet of paper or the skin's surface.

Beta particles are much lighter than alpha particles. They can travel as fast as 161,000 kps (100,000 mps) and can travel in the air for a distance of about 3 meters (m) (10 feet [ft]). Beta particles can pass through a sheet of paper but may be stopped by a thin sheet of aluminum foil or glass.

Gamma and x rays, unlike alpha or beta particles, are waves of pure energy. Gamma rays travel at the speed of light (300,000 kps [186,000 mps]). Gamma radiation is very penetrating and requires a thick wall of concrete, lead, or steel to stop it.

The neutron is another particle that contributes to radiation exposure, both directly and indirectly. Indirect exposure is associated with the gamma rays and alpha particles that are emitted following neutron capture in matter. A neutron has about one quarter the weight of an alpha particle and can travel at speeds of up to 38,600 kps (24,000 mps). Neutrons are more penetrating than beta particles, but less penetrating than gamma rays. They can effectively be shielded by water, graphite, paraffin, or concrete.

The radioactivity of a material decreases with time. The time it takes a material to lose half of its original radioactivity is its half-life. For example, a quantity of iodine-131, a material that has a half-life of 8 days, will lose half of its radioactivity in that amount of time. In 8 more days, half of the remaining radioactivity will be lost, and so on. Eventually, the radioactivity will essentially disappear. Each radioactive element has a characteristic half-life. The half-lives of various radioactive elements may vary from millionths of a second to millions of years.

As a radioactive element gives up its radioactivity, it often changes to an entirely different element, one that may or may not be radioactive. Eventually, a stable element is formed. This transformation may take place in several steps and is known as a decay chain. Radium, for example, is a naturally occurring radioactive element with a half-life of 1,622 years. It emits an alpha particle and becomes radon, a radioactive gas with a half-life of only 3.8 days. Radon decays to polonium and, through a series of steps, to bismuth and ultimately to lead.

Units of Radiation Measure. Scientists and engineers use a variety of units to measure radiation. These different units can be used to determine the amount, type, and intensity of radiation. Just as heat can be measured in terms of its intensity or its effects, using units of calories or degrees, amounts of radiation can be measured in curies, rads, or rems.

The curie, named after the French scientists Marie and Pierre Curie, describes the "intensity" of a sample of radioactive material. The rate of decay of 1 gram of radium is the basis of this unit of measure. It is equal to 3.7x10 *10* disintegrations (decays) per second.

The total energy absorbed per unit quantity of tissue is referred to as absorbed dose. The rad is the unit of measurement for the physical absorption of radiation. Much like sunlight heats the pavement by giving up an amount of energy to it, radiation gives up rads of energy to objects in its path. One rad is equal to the amount of radiation that leads to the deposition of 0.01 joule of energy per kilogram (kg) of absorbing material.

A rem is a measurement of the dose from radiation based on its biological effects. The rem is used to

measure the effects of radiation on the body, much like degrees Celsius can be used to measure the effects of sunlight heating pavement. Thus, 1 rem of one type of radiation is presumed to have the same biological effects as 1 rem of any other type of radiation. This standard allows comparison of the biological effects of radionuclides that emit different types of radiation.

An individual may be exposed to ionizing radiation externally from a radioactive source outside the body and/or internally from ingesting radioactive material. An external dose is delivered only during the actual time of exposure to the external radiation source. An internal dose, however, continues to be delivered as long as the radioactive source is in the body, although both radioactive decay and elimination of the radionuclide by ordinary metabolic processes decrease the dose rate with the passage of time. The dose from internal exposure is calculated over 50 years following the initial exposure.

The three types of doses calculated in this PEIS include an external dose, an internal dose, and a combined external and internal dose. Each type of dose is discussed below.

External Dose. The external dose can arise from several different pathways. All these pathways are similar because the radiation causing the exposure is external to the body. In this PEIS, these pathways include being exposed to a cloud of radiation passing over the receptor, standing on ground that is contaminated with radioactivity, swimming in contaminated water, and boating in contaminated water. The appropriate measure of dose is called the effective dose equivalent. It should be noted that if the receptor departs from the source of radiation exposure, his dose rate will be reduced. It is assumed that external exposure occurs uniformly during the year.

Internal Dose. The internal dose arises from a radiation source entering the human body through ingestion of contaminated food and water or inhalation of contaminated air. In this PEIS, pathways for internal exposure include ingestion of crops contaminated by airborne radiation that has been deposited on the crops or by irrigation of crops using contaminated water sources, ingestion of animal products from animals that ingested contaminated food, ingestion of contaminated water, inhalation of contaminated air, and absorption of contaminated water through the skin during swimming. Unlike external exposures, once radioactive material enters the body, it remains there for various periods of time depending on decay and biological elimination rates. The unit of measure for internal doses is the committed dose equivalent. It is the internal dose that each body organ receives from 1 "year intake" (ingestion plus inhalation). Normally, a 50- or 70-year dose-commitment period is used (i.e., the 1-year intake period plus 49 or 69 years). The dose rate increases during the 1 year of intake. The dose rate, after the 1 year of intake, slowly declines as the radioactivity in the body continues to produce a dose. The integral of the dose rate over the 50 or 70 years gives the committed dose equivalent. In this PEIS, a 50-year dose-commitment period was used.

The various organs of the body have different susceptibilities to harm from radiation. The committed effective dose equivalent takes these different susceptibilities into account and provides a broad indicator of the risk to the health of an individual from radiation. It is obtained by multiplying the committed dose equivalent in each major organ or tissue by a weighting factor associated with the risk susceptibility of the tissue or organ, then summing the totals.

The committed dose equivalent to an organ is larger than the committed effective dose equivalent because the organ has a weighting factor of less than one. The concept of committed effective dose equivalent applies only to internal pathways.

Differences in radionuclide characteristics lead to different internal doses. For example, for the same amount of radioactivity, in curies, taken into the body, the dose from tritium is much less than from uranium or plutonium. Tritium emits a weak beta particle and is biologically eliminated from the body over several weeks. Uranium and plutonium emit relatively high-energy alpha particles and are retained in the body for periods of several months to many years.

Combined External and Internal Dose. For convenience, the sum of the committed effective dose equivalent from internal pathways and the effective dose equivalent from external pathways is also called the committed effective dose equivalent in this PEIS (note that in DOE Order 5400.5, Radiation Protection of the Public and the Environment, this quantity is called the effective dose equivalent).

The units used in this PEIS for committed dose equivalent, effective dose equivalent, and committed effective dose equivalent to an individual are the rem and millirem (mrem) (1/1000 of 1 rem). The corresponding unit for the collective dose to a population (the sum of the doses to members of the population, or the product of the number of exposed individuals and their average dose) is the person-rem.

Sources of Radiation. The average American receives a total of about 350 mrem per year from all sources of radiation, both natural and manmade. The sources of radiation can be divided into six different categories: cosmic radiation, terrestrial radiation, internal radiation, consumer products, medical diagnosis and therapy, and other sources. Each category is discussed below.

Cosmic radiation is ionizing radiation resulting from energetic charged particles from space continuously hitting the earth's atmosphere. These particles and the secondary particles and photons they create are cosmic radiation. Because the atmosphere provides some shielding against cosmic radiation, the intensity of this radiation increases with altitude above sea level. For the sites considered in this PEIS, the cosmic radiation ranged from about 30 to 50 mrem per year. The average annual dose to people in the United States is about 27 mrem.

External terrestrial radiation is the radiation emitted from the radioactive materials in the earth's rocks and soils. The average annual dose from external terrestrial radiation is about 28 mrem. The external terrestrial radiation for the sites in this PEIS ranged from about 30 to 75 mrem per year.

Internal radiation arises from the human body metabolizing natural radioactive material that has entered the body by inhalation or ingestion. Natural radionuclides in the body include isotopes of uranium, thorium, radium, radon, polonium, bismuth, potassium, rubidium, and carbon. The major contributors to the annual dose equivalent for internal radioactivity are the short-lived decay products of radon which contribute about 200 mrem per year. The average dose from other internal radionuclides is about 39 mrem per year.

Consumer products also contain sources of ionizing radiation. In some products, like smoke detectors and airport x-ray machines, the radiation source is essential to the products' operation. In other products, such as televisions and tobacco products, the radiation occurs incidentally to the product function. The average annual dose is about 10 mrem.

Radiation is an important diagnostic medical tool and cancer treatment. Diagnostic x rays result in an average annual exposure of 39 mrem. Nuclear medical procedures result in an average annual

exposure of 14 mrem.

There are a few additional sources of radiation that contribute minor doses to individuals in the United States. The doses from nuclear fuel cycle facilities, such as uranium mines, mills, and fuel processing plants; nuclear power plants; and transportation routes has been estimated to be less than 1 mrem per year. Radioactive fallout from atmospheric atomic bomb tests, emissions of radioactive material from Department of Energy (DOE) facilities, emissions from certain mineral extraction facilities, and transportation of radioactive materials contributes less than 1 mrem per year to the average dose to an individual. Air travel contributes approximately 1 mrem per year to the average dose.

The collective (or population) dose to an exposed population is calculated by summing the estimated doses received by each member of the exposed population. This total dose received by the exposed population is measured in person-rem. For example, if 1,000 people each received a dose of 1 mrem (0.001 rem), the collective dose is 1,000 persons x 0.001 rem = 1.0 person-rem. Alternatively, the same collective dose (1.0 person-rem) results from 500 people, each of whom received a dose of 2 mrem (500 persons x 2 mrem = 1 person-rem).

Limits of Radiation Exposure. The amount of manmade radiation that the public may be exposed to is limited by Federal regulations. Although most scientists believe that radiation absorbed in small doses over several years is not harmful, U.S. Government regulations assume that the effects of all radiation exposures are cumulative.

The exposure to a member of the general public from DOE facility releases into the atmosphere is limited by the Environmental Protection Agency (EPA) to an annual dose of 10 mrem, in addition to the natural background and medical radiation normally received (40 Code of Federal Regulations [CFR] 61, Subpart H). DOE also limits to 10 mrem, the dose annually received from material released into the atmosphere (DOE Order 5400.5). EPA and DOE also limit the annual dose to the general public from radioactive releases to drinking water to 4 mrem (40 CFR 141; DOE Order 5400.5). The DOE annual limit of radiation dose to a member of the general public from all DOE facilities is 100 mrem total from all pathways (DOE Order 5400.5). For people working in an occupation that involves radiation, DOE and the Nuclear Regulatory Commission (NRC) limit doses to 5 rem (5,000 mrem) in any one year (10 CFR 20; 10 CFR 835).

E.2.1.2 Health Effects

Radiation exposure and its consequences are topics of interest to the general public. For this reason, this PEIS places much emphasis on the consequences of exposure to radiation, even though the effects of radiation exposure under most circumstances evaluated in this PEIS are small. This section explains the basic concepts used in the evaluation of radiation effects in order to provide the background for later discussion of impacts.

Radiation can cause a variety of ill-health effects in people. The most significant ill-health effects that result from environmental and occupational radiation exposure are cancer fatalities. These ill-health effects are referred to as "latent" cancer fatalities because the cancer may take many years to develop and for death to occur and may not actually be the cause of death. In the discussions that follow, it should be noted that all fatal cancers are latent; therefore, the term "latent" is not used.

Health impacts from radiation exposure, whether from sources external or internal to the body,

generally are identified as "somatic" (affecting the individual exposed) or "genetic" (affecting descendants of the exposed individual). Radiation is more likely to produce somatic effects rather than genetic effects. Therefore, for this PEIS, only the somatic risks are presented. The somatic risks of most importance are the induction of cancers. Except for leukemia, which can have an induction period (time between exposure to carcinogen and cancer diagnosis) of as little as 2 to 7 years, most cancers have an induction period of more than 20 years.

For a uniform irradiation of the body, the incidence of cancer varies among organs and tissues. The thyroid and skin demonstrate a greater sensitivity than other organs; however, such cancers also produce relatively low mortality rates because they are relatively amenable to medical treatment. Because of the readily available data for cancer mortality rates and the relative scarcity of prospective epidemiologic studies, somatic effects leading to cancer fatalities rather than cancer incidence are presented in this PEIS. The numbers of cancer fatalities can be used to compare the risks among the various alternatives.

The fatal cancer risk estimators presented in this appendix for radiation technically apply only to low-Linear Energy Transfer radiation (gamma rays and beta particles). However, on a per rem rather than a per rad basis, the fatal risk estimators are higher for this type of radiation than for high-Linear Energy Transfer radiation (alpha particles). In this PEIS, the low-Linear Energy Transfer risk estimators are conservatively assumed to apply to all radiation exposures.

The National Research Council's Committee on the Biological Effects of Ionizing Radiations (BEIR) has prepared a series of reports to advise the U.S. Government on the health consequences of radiation exposure. The latest of these reports, *Health Effects of Exposure to Low Levels of Ionizing Radiation BEIR V*, published in 1990, provides the most current estimates for excess mortality from leukemia and cancers other than leukemia expected to result from exposure to ionizing radiation. The BEIR V Report updates the models and risk estimates provided in the earlier report of the BEIR III Committee, *The Effects of Exposure of Populations to Low-Levels of Ionizing Radiation,* published in 1980. BEIR V models were developed for application to the U.S. population.

BEIR V provides estimates that are consistently higher than those in BEIR III. This is attributed to several factors, including the use of a linear dose response model for cancers other than leukemia, revised dosimetry for the Japanese atomic bomb survivors, and additional followup studies of the atomic bomb survivors and other cohorts. BEIR III employs constant relative and absolute risk models, with separate coefficients for each sex and several age-at-exposure groups, while BEIR V develops models in which the excess relative risk is expressed as a function of age at exposure, time after exposure, and sex for each of several cancer categories. BEIR III models were based on the assumption that absolute risks are comparable between the atomic bomb survivors and the U.S. population, while BEIR V models were based on the assumption that the relative risks are comparable. For a disease such as lung cancer, where baseline risks in the United States are much larger than those in Japan, the BEIR V approach leads to larger risk estimates than the BEIR III approach.

The models and risk coefficients in BEIR V were derived through analyses of relevant epidemiologic data, including the Japanese atomic bomb survivors, ankylosis spondylitis patients, Canadian and Massachusetts fluoroscopy patients (breast cancer), New York postpartum mastitis patients (breast cancer), Israel tinea capitis patients (thyroid cancer), and Rochester thymus patients (thyroid cancer). Models for leukemia, respiratory cancer, digestive cancer, and other cancers used only the atomic bomb survivor data, although results of analyses of the ankylosis spondylitis patients were

considered. Atomic bomb survivor analyses were based on revised dosimetry with an assumed Relative Biological Effectiveness of 20 for neutrons and were restricted to doses of less than 400 rads. Estimates of risks of fatal cancers other than leukemia were obtained by totaling the estimates for breast cancer, respiratory cancer, digestive cancer, and other cancers.

Risk Estimates for Doses Received During an Accident. BEIR V includes risk estimates for a single exposure of 10 rem to a population of 100,000 people (10 *6* person-rem). In this case, fatality estimates for leukemia, breast cancer, respiratory cancer, digestive cancer, and other cancers are given for both sexes and nine age-at-exposure groups. These estimates, based on the linear model, are summarized in table E.2.1.2-1. The average risk estimate from all ages and both sexes is 885 excess cancer fatalities per million person-rem. This value has been conservatively rounded up to 1,000 excess cancer fatalities per million person-rem.

Table E.2.1.2-1.-- Lifetime Risks per 100,000 Persons Exposed to a Single Exposure of 10 Rem

Gender	Type of Fatal Cancer		
	Leukemia 1	Cancers Other Than Leukemia	Total Cancers
Male	220	660	880
Female	160	730	890
Average	190	695	885 2

Although values for other health effects are not presented in this PEIS, the risk estimators for nonfatal cancers and for genetic disorders in future generations are estimated to be approximately 200 and 260 per million person-rem, respectively. These values are based on information presented in the 1990 Recommendations of the International Commission on Radiological Protection (ICRP Publication 60) and are seen to be 20 and 26 percent, respectively, of the fatal cancer estimator (ICRP 1991a:22). Thus, if the number of excess fatal cancers is projected to be "Z", the number of excess genetic disorders would be 0.26xZ.

Risk Estimates for Doses Received During Normal Operation. For low doses and dose rates, a linear-quadratic model was found to provide a significantly better fit to the data for leukemia than a linear one, and leukemia risks were based on a linear-quadratic function. This reduces the effects by a factor of two over estimates that are obtained from the linear model. For other cancers, linear models were found to provide an adequate fit to the data, and were used for extrapolation to low doses. However, the BEIR V Committee recommended reducing these linear estimates by a factor between 2 and 10 for doses received at low dose rates. For this PEIS, a risk reduction factor of 2 was adopted for conservatism.

Based on the above discussion, the resulting dose-to-risk conversion factor would be equal to half the value observed for accident situations or approximately 500 excess fatal cancers per million person-rem (0.0005 excess fatal cancers per person-rem). This is the risk value used in this PEIS to calculate fatal cancers to the general public during normal operation. For workers, a dose-to-risk conversion factor of 400 excess fatal cancers per million person-rem (0.0004 excess fatal cancers per person-

rem) is used in this PEIS. This lower value reflects the absence of children in the workforce. Again, based on information provided in ICRP Publication 60, the health risk estimators for nonfatal cancers and genetic disorders among the public are 20 percent and 26 percent, respectively, of the fatal cancer dose-to-risk conversion factor. For workers, the health risk estimators for nonfatal cancers and genetic disorders are both 20 percent of the fatal cancer dose-to-risk conversion factor. For this PEIS, only fatal cancers are presented.

The risk estimates may be applied to calculate the effects of exposing a population to radiation. For example, in a population of 100,000 people exposed only to natural background radiation (0.3 rem per year), 15 cancer fatalities per year would be inferred to be caused by the radiation (100,000 persons x 0.3 rem per year x 0.0005 cancer fatalities per person-rem = 15 cancer fatalities per year).

Sometimes, calculations of the number of excess cancer fatalities associated with radiation exposure do not yield whole numbers and, especially in environmental applications, may yield numbers less than 1.0. For example, if a population of 100,000 were exposed as above, but to a total dose of only 0.001 rem, the collective dose would be 100 person-rem, and the corresponding estimated number of cancer fatalities would be 0.05 (100,000 persons x 0.001 rem x 0.0005 cancer fatalities/person-rem = 0.05 fatal cancers).

How should one interpret a nonintegral number of cancer fatalities such as 0.05? The answer is to interpret the result as a statistical estimate. That is, 0.05 is the *average* number of deaths that would result if the same exposure situation were applied to many different groups of 100,000 people. In most groups, no person (0 people) would incur a cancer fatality from the 0.001 rem dose each member would have received. In a small fraction of the groups, one fatal cancer would result; in exceptionally few groups, two or more fatal cancers would occur. The *average* number of deaths over all the groups would be 0.05 fatal cancers (just as the average of 0, 0, 0, and 1 is 1/4, or 0.25). The most likely outcome is 0 cancer fatalities.

These same concepts apply to estimating the effects of radiation exposure on a single individual. Consider the effects, for example, of exposure to background radiation over a lifetime. The "number of cancer fatalities" corresponding to a single individual's exposure over a (presumed) 72-year lifetime to 0.3 rem per year is the following:

1 person x 0.3 rem/year x 72 years x 0.0005 cancer fatalities/person-rem = 0.011 cancer fatalities.

Again, this should be interpreted in a statistical sense; that is, the estimated effect of background radiation exposure on the exposed individual would produce a 1.1-percent chance that the individual might incur a fatal cancer caused by the exposure. Presented another way, this method estimates that approximately 1.1 percent of the population might die of cancers induced by the background radiation.

E.2.2 Methodology for Estimating Radiological Impacts of Normal Operation

The radiological impacts of normal operation of alternatives were calculated using Version 1.485 of the GENII computer code. Site-specific and technology-specific input data were used, including location, meteorology, population, food production and consumption, and source terms. The GENII code was used for analysis of normal operations and design basis accidents. Section E.2.2.1 briefly describes GENII and outlines the approach used for normal operations.

E.2.2.1 GENII Computer Code

The GENII computer model, developed by Pacific Northwest Laboratory for DOE, is an integrated system of various computer modules that analyze environmental contamination resulting from acute or chronic releases to, or initial contamination in, air, water, or soil. The model calculates radiation doses to individuals and populations. The GENII computer model is well documented for assumptions, technical approach, methodology, and quality assurance issues (*GENII -- The Hanford Environmental Radiation Dosimetry Software System* [December 1988]). The GENII computer model has gone through extensive quality assurance and quality control steps. These include the comparison of results from model computations against those from hand calculations, and the performance of internal and external peer reviews. Recommendations given in these reports were incorporated into the final GENII computer model, as deemed appropriate.

For this PEIS only the ENVIN, ENV, and DOSE computer modules were used. The codes are connected through data transfer files. The output of one code is stored in a file that can be used by the next code in the system. In addition, a computer code called CREGENII was prepared to aid the user with the preparation of input files into GENII.

CREGENII. The CREGENII code helps the user, through a series of interactive menus and questions, prepare a text input file for the environmental dosimetry programs. In addition, CREGENII prepares a batch processing file to manage the file handling needed to control the operations of subsequent codes and to prepare an output report.

ENVIN. The ENVIN module of the GENII code controls the reading of the input files prepared by CREGENII and organizes the input for optimal use in the environmental transport and exposure module, ENV. The ENVIN code interprets the basic input, reads the basic GENII data libraries and other optional input files, and organizes the input into sequential segments on the basis of radionuclide decay chains.

A standardized file that contains scenario, control, and inventory parameters is used as input to ENVIN. Radionuclide inventories can be entered as functions of releases to air or water, concentrations in basic environmental media (air, soil, or water), or concentrations in foods. If certain atmospheric dispersion options have been selected, this module can generate tables of atmospheric dispersion parameters that will be used in later calculations. If the finite plume air submersion option is requested in addition to the atmospheric dispersion calculations, preliminary energy-dependent finite plume dose factors also are prepared. The ENVIN module prepares the data transfer files that are used as input by the ENV module; ENVIN generates the first portion of the calculation documentation--the run input parameters report.

ENV. The ENV module calculates the environmental transfer, uptake, and human exposure to radionuclides that result from the chosen scenario for the user-specified source term. The code reads the input files from ENVIN and then, for each radionuclide chain, sequentially performs the precalculations to establish the conditions at the start of the exposure scenario. Environmental concentrations of radionuclides are established at the beginning of the scenario by assuming decay of preexisting sources, considering biotic transport of existing subsurface contamination, and defining soil contamination from continuing atmospheric or irrigation depositions. Then, for each year of postulated exposure, the code estimates air, surface soil, deep soil, groundwater, and surface water concentrations of each radionuclide in the chain. Human exposures and intakes of each radionuclide

are calculated for pathways of external exposure from finite atmospheric plumes, inhalation, external exposure from contaminated soil, sediments, and water, external exposure from special geometries, and internal exposures from consumption of terrestrial foods, aquatic foods, drinking water, animal products, and inadvertent intake of soil. The intermediate information on annual media concentrations and intake rates are written to data transfer files. Although these may be accessed directly, they are usually used as input to the DOSE module of GENII.

GENII is a general purpose computer code used to model dispersion, transport, and long-term exposure effects of specific radionuclides and pathways. Sophisticated codes such as UFOTRI and ETMOD (Environmental Tritium Model) are used exclusively for modeling tritium transport and dosimetry. The UFOTRI and ETMOD codes were not chosen for use in this PEIS because of the lack of information on detailed facility design and on the breakdown of tritium into elemental and tritiated water forms, and because these codes cannot be used for modeling the exposure effects of radionuclides other than tritium. GENII was chosen because it can model both air and surface transport pathways and is not restricted to any radionuclides.

DOSE. The DOSE module reads the annual intake and exposure rates defined by the ENV module and converts the data to radiation dose. External dose is calculated with precalculated factors from the EXTDF module or from a data file prepared outside of GENII. Internal dose is calculated with precalculated factors from the INTDF module.

EXTDF. The EXTDF module calculates the external dose-rate factors for submersion in an infinite cloud of radioactive materials, immersion in contaminated water, and direct exposure to plane or slab sources of radionuclides. EXTDF was not used. Instead, the dose rate factors listed in *External Dose Rate Factors for Calculation of Dose to the Public* (DOE/EH-0070) were used for this PEIS.

INTDF. Using the *Limits for Intakes of Radionuclides by Workers* (ICRP Publication 30) model, the INTDF module calculates the internal (inhalation and ingestion) dose conversion factors of radionuclides for specific organs. The factors generated by INTDF were used for the calculations presented in this PEIS.

E.2.2.2 Data and Assumptions

In order to perform the dose assessments for this PEIS, different types of data must be collected and/or generated. In addition, calculational assumptions have to be made. This section discusses the data collected and/or generated for use in the dose assessment and assumptions made for this PEIS.

Meteorological Data. The meteorological data used for all applicable DOE sites were in the form of joint frequency data files. A joint frequency data file is a table listing the fractions of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The joint frequency data files were based on measurements over a 1-year period at various locations and at different heights at the sites. Average meteorological conditions (averaged over the 1-year period) were used for normal operation. For use in design basis accidents, the 50 percentile option was used.

Population Data. Population distributions were based on *1990 Census of Population and Housing* data. Projections were determined for the year 2030 for areas within 80 km (50 mi) of the proposed facilities at each candidate site. This year of analysis was selected as conservatively representative of the population over the operational period evaluated, and was used in the impact assessments. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances up to

80 km (50 mi). The grid was centered on the facility from which the radionuclides were assumed to be released.

Source Term Data. The source terms (quantities of radionuclides released into the environment over a given period) were estimated on the basis of latest conceptual designs of facilities and experience with similar facilities. The source terms used to generate the estimated impacts of normal operation are provided in section E.2.3.

Food Production and Consumption Data. Data from the 1987 Census of Agriculture were used to generate site-specific data for food production. Food production was spatially distributed on the same circular grid as was used for the population distributions. The consumption rates were those used in GENII for the maximum individual and average individual. People living within the 80 km (50 mi) assessment area were assumed to consume only food grown in that area.

Calculational Assumptions. Dose assessments were performed for members of the general public and workers. Dose assessments for members of the public were performed for two different types of receptors considered in this PEIS: a maximally exposed offsite individual and the general population living within 80 km (50 mi) of the facility. It was assumed that the maximally exposed individual was located at a position on the site boundary that would yield the highest impacts during normal operation of a given alternative. If more than one facility was assumed to be operating at a site, the dose to the individual from each facility was calculated. The doses were then summed to give the total dose to the individual. A 80 km (50 mi) population dose was calculated for each operating facility at a site. These doses were then added to give the total population dose at that site.

To estimate the radiological impacts from normal operation of Stockpile Stewardship and Management alternatives, additional assumptions and factors were considered in using GENII:

- No prior deposition of radionuclides on ground surfaces was assumed.
- For the maximally exposed offsite individual, the annual exposure time to the plume and to soil contamination was 0.7 years (NRC 1977b:1.109-68).
- For the population, the annual exposure time to the plume and to soil contamination was 0.5 years (NRC 1977b:1.109-68).
- A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops and animal products contaminated by either deposition of radioactivity from the air or irrigation, ingestion of fish and other aquatic food raised in contaminated water, exposure through swimming and boating in contaminated surface water, and ingestion of contaminated water. It should be noted that not all pathways were available at every site.
- For atmospheric releases, it was assumed that ground-level releases would occur for all stockpile stewardship and management designated facilities. For site-dependent facilities, reported release heights were used and assumed to be the effective stack height. Use of the effective stack height negates plume rise, thereby making the resultant doses conservative.
- The calculated doses were 50-year committed doses from 1 year of intake.

Resuspension of particulates was not considered because prior calculations of dust loading in the atmosphere showed that this pathway was negligible compared with others. The exposure, uptake, and usage parameters used in the GENII model are provided in tables E.2.2.2-1 through E.2.2.2-4.

Annual average doses to workers for No Action at all DOE sites were based on measured values

received by radiation workers during the 1992 time period. The average No Action dose received by a worker at these sites in future years was assumed to remain the same as the annual average during the 1992 period. The total workforce dose in future years was calculated by multiplying the average worker dose by a projected number of future workers.

Table E.2.2.2-1.-- GENII Annual Exposure Parameters to Plumes and Soil Contamination

Maximally Exposed Individual				General Population			
External Exposure (hours)		Inhalation of Plume		External Exposure (hours)		Inhalation of Plume	
Plume	Soil Contamination	Exposure Time (hours)	Breathing Rate (cc/s)	Plume	Soil Contamination	Exposure Time (hours)	Breathing Rate (cc/s)
6,136	6,136	6,136	270	4,383	4,383	4,383	270
HNUS 1995a.							

Table E.2.2.2-2.-- GENII Annual Usage Parameters for Consumption of Terrestrial Food

	Maximally Exposed Individual				General Population			
Food Type	Growing Time (days)	Yield (kg/m 2)	Holdup Time (days)	Consumption Rate (kg/yr)	Growing Time (days)	Yield (kg/m 2)	Holdup Time (days)	Consumption Rate (kg/yr)
Leafy vegetables	90.0	1.5	1.0	30.0	90.0	1.5	14.0	15.0
Root vegetables	90.0	4.0	5.0	220.0	90.0	4.0	14.0	140.0

Fruit	90.0	2.0	5.0	333	90.0	2.0	14.0	64.0
Grains/cereals	90.0	0.8	180.0	80.0	90.0	0.8	180.0	72.0
HNUS 1995a.								

Table E.2.2.2-3.-- GENII Annual Usage Parameters for Consumption of Animal Products

	Maximally Exposed Individual										
	Human Consumption		**Stored Feed**				**Fresh Forage**				
Food Type	**Consumption Rate (kg/yr)**	**Holdup Time (days)**	**Diet Fraction**	**Growing Time (days)**	**Yield (kg/m 3)**	**Storage Time (days)**	**Diet Fraction**	**Growing Time (days)**	**Yield (kg/m 3)**	**St T (d**
Beef	80.0	15.0	0.25	90.0	0.80	180.0	0.75	45.0	2.00	10
Poultry	18.0	1.0	1.00	90.0	0.80	180.0				
Milk	270.0	1.0	0.25	45.0	2.00	100.0	0.75	30.0	1.50	0.0

Eggs	30.0	1.0	1.00	90.0	0.80	180.0				
	General Population									
Beef	70.0	34.0	0.25	90.0	0.80	180.0	0.75	45.0	2.00	10
Poultry	8.5	34.0	1.00	90.0	0.80	180.0				
Milk	230.0	4.0	0.25	45.0	2.00	100.0	0.75	30.0	1.50	0.0
Eggs	20.0	18.0	1.00	90.0	0.80	180.0				
HNUS 1995a.										

Table E.2.2.2-4.-- GENII Annual Usage Parameters for Aquatic Activities

	Maximally Exposed Individual			General Population		
Activity	Transit Time to Usage Point (days)	Holdup Time (days)	Usage Rate (per year)	Transit Time to Usage Point (days)	Holdup Time (days)	Usage Rate

Drinking water	0.0	0.0	730 L		0.0	0.0	Site dependent
Swimming	0.0	0.0	100 hours		0.0	0.0	Site dependent
Boating	0.0	0.0	100 hours		0.0	0.0	Site dependent
Shoreline	0.0	0.0	500 hours		0.0	0.0	Site dependent
Ingestion of fish	0.0	0.0	40 kg		0.0	0.0	Site dependent
Ingestion of mollus	0.0	0.0	6.9 kg		0.0	0.0	Site dependent
Ingestion of crusta	0.0	0.0	6.9 kg		0.0	0.0	Site dependent
Ingestion of plants	0.0	0.0	6.9 kg		0.0	0.0	Site dependent
HNUS 1995a.							

Doses to workers directly associated with stewardship and management facilities were taken either from data reports prepared by the DOE Complex sites or from occupational dose histories for similar operations. To obtain the total workforce dose at a site with particular stewardship and/or management facilities in operation, the site dose from No Action was added to that from the facilities being evaluated. The average dose to a site worker was then calculated by dividing this dose by the total number of workers at the site. All doses to workers include a component associated with the intake of radioactivity into the body and another component resulting from external exposure to direct radiation.

E.2.2.3 Health Effects Calculations

Doses calculated by GENII were used to estimate health effects using the risk estimators presented in section E.2.1.2. The incremental cancer fatalities in the general population and groups of workers due to radiation exposure were therefore estimated by multiplying the collective combined effective dose equivalent by 0.0005 and 0.0004 fatal cancers/person-rem, respectively. In this PEIS, the collective combined effective dose equivalent is the sum of the collective committed effective dose equivalent (internal dose) and the collective effective dose equivalent (external dose), section E.2.1.1.

Although health risk factors are statistical factors and therefore not strictly applicable to individuals, they have been used in the past to estimate the incremental risk to an individual from exposure to radiation. Therefore, the factors of 0.0005 and 0.0004 per rem of individual committed effective dose equivalent for a member of the public and for a worker, respectively, have also been used in this PEIS to calculate the individual's incremental fatal cancer risk from exposure to radiation.

For the public, the health effects expressed in this PEIS are the risk of fatal cancers for the maximally exposed individual and the number of fatal cancers in the 80 km (50 mi) population from exposure to radioactivity released from any site over the 25-year operational period. For workers, the health

effects expressed are the risk to the average worker at a site and the number of fatal cancers to all workers at the site from 25 years of site operation.

E.2.3 Normal Operation Releases

This section presents source terms (i.e., radiological releases) to the environment from the normal operation of stockpile management alternatives at each of the applicable proposed sites (Oak Ridge Reservation [ORR], table E.2.3-1; Savannah River Site [SRS], table E.2.3-2; Pantex Plant [Pantex], table E.2.3-3; Los Alamos National Laboratory [LANL], tables E.2.3-4 and E.2.3-5; Lawrence Livermore National Laboratory [LLNL], table E.2.3-6; and Nevada Test Site [NTS], table E.2.3-7). These source terms were used in the GENII dose model calculations, which were ultimately used in estimating the most conservative radiological impacts at each site from each of the applicable management alternatives presented in this PEIS. These resultant incremental doses (and associated cancer risks) can be found in sections 4.2.3.9, 4.3.3.9, 4.5.3.9, 4.6.3.9, 4.7.3.9, and 4.9.3.9, respectively, by subtracting the applicable site's No Action impacts from each management alternative's impact total. Only atmospheric releases have been presented because liquid radiological discharges are not expected from any of the alternatives at any of the sites.

Table E.2.3-1.-- Normal Operational Atmospheric Releases for the Y-12 Downsize Secondary and Case Fabrication Alternative

Isotope	Release (Ci)
Uranium-235	4.2x10 -4
Uranium-238	1.5x10 -3
OR MMES 1996j.	

Table E.2.3-2.-- Normal Operational Atmospheric Releases for the Savannah River Site Pit Fabrication Alternative

Isotope	Release (Ci)
Plutonium-238	1.9x10 -8
Plutonium-239	1.3x10 -7
Plutonium-240	3.0x10 -8
Plutonium-241	9.0x10 -7
Americium-241	2.8x10 -8

Total	1.1x10 -6
Representative of unclassified isotopic distribution associated with weapons-grade plutonium. **LANL1995g.**	

Table E.2.3-3.-- Normal Operational Atmospheric Releases for the Pantex Plant Downsize Assembly/Disassembly Alternative

Isotope	Release (Ci)
Hydrogen-3	0.45
PX MH 1995a.	

Table E.2.3-4.-- Normal Operational Atmospheric Releases for the Los Alamos National Laboratory Pit Fabrication Alternative

Isotope	Release (Ci)
Plutonium-238	1.9x10 -8
Plutonium-239	1.3x10 -7
Plutonium-240	3.0x10 -8
Plutonium-241	9.0x10 -7
Americium-241	2.8x10 -8
Total	1.1x10 -6
Representative of unclassified complete isotopic distribution associated with weapons-grade plutonium. **LANL 1995g.**	

Table E.2.3-5.-- Normal Operational Atmospheric Releases for the Los Alamos National Laboratory Secondary and Case Fabrication Alternative

Isotope	Release (Ci)
Uranium-235	4.9×10^{-4}
Uranium-238	1.8×10^{-3}
LANL 1995e.	

Table E.2.3-6.-- Normal Operational Atmospheric Releases for the Lawrence Livermore National Laboratory Secondary and Case Fabrication Alternative

Isotope	Release (Ci)
Uranium-235	1.4×10^{-4}
Uranium-238	4.8×10^{-4}
LLNL 1995c.	

Table E.2.3-7.-- Normal Operational Atmospheric Releases for the Nevada Test Site Assembly/Disassembly Alternative

Isotope	Release (Ci)
Hydrogen-3	0.45
PX MH 1995a.	

E.3 Hazardous Chemical Impacts to Human Health

E.3.1 Background

Two general types of adverse human health effects are assessed for hazardous chemical exposure in this PEIS. These are carcinogenic and noncarcinogenic effects. A Chemical Health Effects Technical Reference (TTI 1996b) was developed to assist the risk assessor in the evaluation process. Part I of

the Technical Reference contains a table of chemical toxicity profiles which characterizes each chemical in terms of physical properties, potential exposure routes, and the effects on target tissues/organs that might be expected. It is to be used qualitatively by the risk assessor to determine how exposure might occur (exposure route), what tissue or organ system might be impacted (e.g., central nervous system dysfunction, or liver cancer), and whether the chemical might possess other properties affecting its bioavailability in a given matrix (e.g., air, water, or soil). Part II of the Technical Reference contains a table of exposure limits which provides the risk assessor with the necessary information to calculate risk or expected adverse effects should an individual be exposed to a hazardous chemical for a long time at low levels (chronic exposure) or to higher concentrations for a short-term (acute) exposure. Where a dose effect calculation is required (milligram [mg]/kg/day), the reference dose is applicable, and where an inhalation concentration effect is required, the reference concentration (i.e., RfC in mg/m3) is applicable for chronic exposures. The permissible exposure limit values, which regulate worker exposures over 8-hour periods, determine the concentration allowed for occupational exposures that would be without adverse acute effects. Other values, such as the threshold limit value (TLV), are presented because they are prepared by the American Conference of Governmental Industrial Hygienists for guidance on exposures of 8-hour periods, and can be used to augment permissible exposure limits or serve as exposure levels in the absence of a permissible exposure limit. All currently regulated chemicals associated with each site and every hazardous chemical are presented in the Chemical Health Effects Technical Reference.

It was assumed that under normal operation conditions members of the public would only receive chronic exposures at low levels in the form of air emissions from a centrally located source term at each site. Since hazardous chemicals are not released into surface or groundwaters or onto soil, inhalation is assumed to be the only route of exposure. However, all chemical quantities are accounted for as air emissions which are several orders of magnitude greater than all other possible routes combined. It was further assumed that the maximally exposed individual member of the public would be at the site boundary, and this assumption was used when calculating all public exposures, which under normal operating conditions are expected to be chronic and at very low levels. For worker exposures to hazardous chemicals, it was assumed that individuals were exposed only to low air emission concentrations during an 8-hour day for a 40-hour week for a maximum working lifetime of 40 years. The point of exposure chosen was 100 meters from a centrally located source term, since the precise placement of source terms onsite could not be made. Further, it could not be determined where the involved and noninvolved workers would be relative to the emission sources.

For every site involved in the analysis, hazard indexes (HIs) were calculated for every alternative action relative to the site. The exposure concentrations of hazardous chemicals for the public and the onsite workers were developed using the industrial source complex short-term model recommended for point, area, and volume sources. This model, which estimates dispersion of emissions from these sources, has been field-tested and recommended by the EPA. The modeled concentrations were compared to the reference concentration and permissible exposure limit values unique to each chemical to yield hazard quotients (HQs) for the public and onsite workers, respectively. The HQs were summed to give the HIs for each alternative action at each site, as well as total HIs (i.e., No Action HI + alternative HI). For cancer risk estimation, the inhaled concentrations were converted to doses in mg/kg/day, which were then multiplied by the slope factors unique to each identified carcinogen. The risks for all carcinogens associated with each alternative (incremental risk) at each site were summed, and the No Action cancer risk for each site was added in order to show the total risk should that alternative action be implemented at a given site. 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 chemical health concern.

E.3.2 Chemical Toxicity Profiles

Part I of the Chemical Health Effects Technical Reference provides the pertinent facts about each chemical that is included in the risk assessment of this PEIS. This reference includes the chemical abstracts service number, which aids in a search for information available on any specific chemical and ensures a positive identity regardless of which name or synonym is used. It also contains physical information (i.e., solubility, vapor pressure, and flammability), as well as incompatibility data that is useful in determining whether a hazard might exist and the nature of the hazard. The route of exposure, target organs/tissues, and carcinogenicity provide an abbreviated summary on how individuals may get exposed, what body functions could be affected, and whether chronic exposure could lead to increased cancer incidence in an exposed population.

E.3.3 Regulated Exposure Limits

Hazardous chemicals are regulated by various agencies in order to provide protection to the public (EPA regulated) and to workers (Occupational Safety and Health Administration [OSHA]), while others (National Institute for Occupational Safety and Health and the American Conference of Governmental Industrial Hygienists) provide guidelines. The reference doses and reference concentrations set by EPA represent exposure limits for long-term (chronic) exposure at low doses and concentrations, respectively, that can be considered safe from adverse noncancer effects. The permissible exposure limit represents concentration levels set by OSHA that are safe for 8-hour exposures without causing noncancer adverse effects. The slope factor or the unit risk is used to convert the daily uptake of a carcinogenic chemical averaged over a lifetime to the incremental risk of an individual developing cancer. Part II of the Chemical Health Effects Technical Reference presents the information on exposure limits used to develop HQs for each of the hazardous chemicals and the HIs derived from their summation and the slope factors used to calculate cancer risk for each chemical at the exposure concentrations identified at the various sites or associated with a proposed alternative action.

1
These are the linear estimates and are double the linear-quadratic estimates provided in BEIR V for leukemia at low doses and dose-rates.

2
This value has been rounded up to 1,000 excess cancer fatalities per million person-rem.

NAS 1990a.

E.3.4 Hazardous Chemical Risks/Effects Calculations

Tables E.3.4-1 through E.3.4-30 show the chemicals associated with the various activities and the various sites considered for each alternative. The increment added by each activity to the site is totalled to show how much the risk at the site would increase should that alternative be implemented. Calculations used to derive the hazard indices for workers and for the public are presented as footnotes to each of the appendix tables. In addition, the slope factor used to calculate the cancer risk for workers and for the public are presented as footnotes in the appendix tables, and the footnotes to the tables show how the cancer risk was performed.

Table E.3.4-1.--Risk Assessments from Exposure to Hazardous Chemicals from No Action at (Reservation

Chemical	Regulated Exposure Limits/ Risk Factors			Emissions Inventory		Hazard Quotient		Canc
	RfC (mg/m3)	PEL 1 (mg/m3)	Slope Factor (mg/kg/day)	Boundary Annual MEI2 (mg/m3)	Worker 100 m 8 hours (mg/m3)	Boundary Annual MEI2, 3	Worker 100 m 8 hours 4	Boundar Annual MEI2, !
Acetic acid	0.6125	25	None	3.30x10-8	1.98x10-5	5.39x10-8	7.93x10-7	0
Carbon monoxide	1.35	55	None	3.14x10-3	1.88	2.32x10-3	3.42x10-2	0
Chlorine	0.35	3	None	5.78x10-5	3.47x10-2	1.65x10-4	1.16x10-2	0
Hydrogen chloride	0.0070	7.0	None	2.12x10-4	1.27x10-1	3.03x10-2	1.82x10-2	0

Hydrogen fluoride	0.21	2.49	None	2.31x10-6	1.39x10-3	1.10x10-5	5.57x10-4	0
Methyl alcohol	1.75	260	None	8.72x10-4	5.23x10-1	4.98x10-4	2.01x10-3	0
Nitric acid	0.1225	5	None	3.14x10-4	1.88x10-1	2.56x10-3	3.76x10-2	0
Sulfuric acid	0.0245	1	None	8.25x10-5	4.95x10-2	3.37x10-3	4.95x10-2	0
1,1,1-Trichloroethane (TCA)	1.000	1,900	None	7.26x10-6	4.36x10-3	5.93x10-5	2.29x10-6	0
Volatile organic compounds (toluene)	0.4	766	None	1.22x10-4	7.33x10-2	3.05x10-4	9.57x10-5	0
Hazard Index 7						3.95x10-2	1.54x10-1	
Total Cancer Risk 8								0

Table E.3.4-2.-- Risk Assessments from Exposure to Hazardous Chemicals from Downsize/Con: Secondary and Case Fabrication at Oak Ridge Reservation

Chemical	Regulated Exposure Limits/ Risk Factors			Emissions Inventory		Hazard Quotient		Cancer R	
	RfC (mg/m3)	PEL 9 (mg/m3)	Slope Factor (mg/kg/day)	Boundary Annual MEI10 (mg/m3)	Worker 100 m 8 hours (mg/m3)	Boundary Annual MEI10, 11	Worker 100 m 8 hours 12	Boundary Annual MEI10, 13	W 1 8
Carbon monoxide	1.35	55	None	4.85x10-4	2.91x10-1	3.59x10-4	5.30x10-3	0	0
Chlorine	0.35	3	None	8.91x10-6	5.35x10-3	2.55x10-5	1.78x10-3	0	0
Hydrogen chloride	0.0070	7.0	None	3.17x10-4	1.90x10-1	4.53x10-2	2.72x10-2	0	0
Methyl alcohol	1.75	260	None	9.57x10-4	5.75x10-1	5.47x10-4	2.21x10-3	0	0
Nitric acid	0.1225	5	None	4.62x10-4	2.77x10-1	3.77x10-3	5.65x10-2	0	0
Ozone	0.0049	0.2	None	4.62x10-6	2.77x10-3	9.43x10-4	1.39x10-2	0	0
Sulfuric acid	0.0245	1	None	1.19x10-4	7.13x10-2	4.85x10-3	7.13x10-2	0	0

Uranium-235	0.0105	0.25	None	6.60x10-9	3.96x10-6	6.29x10-7	1.59x10-5	0	0
Uranium-238	0.0105	0.25	None	1.32x10-7	7.93x10-5	1.22x10-5	3.17x10-4	0	0
Volatile organic compounds (toluene)	0.4	766	None	7.92x10-5	4.76x10-2	1.98x10-4	6.21x10-5	0	0
Hazard Index 15						5.60x10-2	1.78x10-1		
Total Cancer Risk 16								0	0

Table E.3.4-3.-- Risk Assessments from Exposure to Hazardous Chemicals from Phaseout of Se Case Fabrication at Oak Ridge Reservation

Chemical	Regulated Exposure Limits/ Risk Factors			Emissions Inventory		Hazard Quotient		Canc
	RfC (mg/m3)	PEL 17 (mg/m3)	Slope Factor (mg/kg/day)	Boundary Annual MEI18 (mg/m3)	Worker 100 m 8 hours (mg/m3)	Boundary Annual MEI18, 19	Worker 100 m 8 hours 20	Boundar Annual MEI18, 21
Carbon monoxide	1.35	55	None	1.36x10-2	2.60	1.01x10-2	4.73x10-2	0

Chlorine	0.35	3	None	2.63x10-4	5.04x10-2	7.51x10-4	1.68x10-2	0
Hydrogen chloride	0.0070	7.0	None	1.12x10-4	2.16x10-2	1.61x10-2	3.08x10-3	0
Methyl alcohol	1.75	260	None	4.30x10-4	8.24x10-2	2.46x10-4	3.17x10-4	0
Nitric acid	0.1225	5	None	1.65x10-4	3.17x10-2	1.35x10-3	6.34x10-3	0
Sulfuric acid	0.0245	1	None	5.29x10-5	1.01x10-2	2.16x10-3	1.01x10-2	0
1,1,1-Trichloroethane (TCA)	0.1225	1,900	None	3.31x10-6	6.34x10-4	2.70x10-5	3.34x10-7	0
Volatile organic compounds (toluene)	0.4	766	None	3.80x10-4	7.29x10-2	9.51x10-4	9.52x10-5	0
Hazard Index 23						3.16x10-2	8.41x10-2	
Total Cancer Risk 24								0

Table E.3.4-4.--Risk Assessments from Exposure to Hazardous Chemicals from No Action at S River Site

Chemical	Regulated Exposure Limits/ Risk Factors			Emissions Inventory		Hazard Quotient		Cancer I	
	RfC (mg/m3)	PEL 25 (mg/m3)	Slope Factor (mg/kg/day)	Boundary Annual MEI26 (mg/m3)	Worker 100 m 8 hours (mg/m3)	Boundary Annual MEI26, 27	Worker 100 m 8 hours 28	Boundary Annual MEI26, 29	\ 8
Benzene	0.0796	3.25	0.029	1.25x10-6	1.37x10-2	1.57x10-5	4.2x10-3	1.04x10-8	1 5
Benzene	0.0796	3.25	0.029	1.23x10-5	1.35x10-1	1.55x10-4	4.15x10-2	1.02x10-7	1 4
Carbon Monoxide	1.35	55	None	5.41x10-3	5.91x10-1	4.01x10-3	1.07	0	0
Chlorine	0.35	3	None	9.27x10-9	1.01x10-4	2.65x10-8	3.37x10-5	0	0
Chloroform	0.035	240	0.0061	4.79x10-6	5.24x10-2	1.37x10-4	2.18x10-4	8.36x10-9	1 -.
Cobalt	0.00245	0.1	None	7.46x10-9	8.15x10-5	3.05x10-6	8.15x10-4	0	0

Hydrogen Fluoride	0.21	2.49	None	4.29x10-8	4.69x10-4	2.04x10-7	1.88x10-4	0		0
Hydrogen Fluoride	0.21	2.49	None	8.39x10-12	9.16x10-8	3.99x10-11	3.68x10-8	0		0
Mercury	0.0003	0.1	None	5.17x10-8	5.65x10-4	1.72x10-4	5.65x10-3	0		0
Mercury (vapor)	0.0003	0.1	None	1.89x10-7	2.06x10-3	6.29x10-4	2.06x10-2	0		0
Mercury oxide	0.0003	0.1	None	6.36x10-18	6.95x10-14	2.12x10-14	6.95x10-13	0		0
Nickel compounds	0.0245	1	0.84	3.16x10-16	3.45x10-12	1.29x10-14	3.45x10-12	7.6x10-17		1 1
Nickel (vapor and compounds)	0.0245	1	0.84	4.31x10-8	4.7x10-4	1.76x10-6	4.7x10-4	1.03x10-8		1 5
Nitric acid	0.1225	5	None	3.73x10-6	4.07x10-2	3.04x10-5	8.15x10-3	0		0
Phosphoric acid	0.0245	1	None	1.5x10-7	1.63x10-3	6.11x10-6	1.63x10-3	0		0

Hazard Index 31						5.16x10-3	1.16		
Total Cancer Risk 32								1.31x10-7	1 4

Table E.3.4-5.--Risk Assessments from Exposure to Hazardous Chemicals from Pit Fabricati Savannah River Site

Chemical	**Regulated Exposure Limits/ Risk Factors**			**Emissions Inventory**		**Hazard Quotient**		**Cancer R**	
	RfC (mg/m3)	**PEL 33 (mg/m3)**	**Slope Factor (mg/kg/day)**	**Boundary Annual MEI34 (mg/m3)**	**Worker 100 m 8 hours (mg/m3)**	**Boundary Annual MEI34, 35**	**Worker 100 m 8 hours 36**	**Boundary Annual MEI34, 37**	**W 1 8**
Carbon monoxide	1.35	55	None	1.06x10-6	1.55x10-2	7.82x10-7	2.10x10-4	0	0
Carbon dioxide	221	9,000	None	6.99x10-5	7.64x10-1	3.16x10-7	8.48x10-5	0	0
Volatile organic compounds (toluene)	0.4	766	None	2.94x10-7	3.21x10-3	7.34x10-7	4.19x10-6	0	0
Hazard Index 39						1.83x10-6	2.99x10-4		

Total Cancer Risk 40								0	0

1

See the Chemical Health Effects Technical Reference (TTI 1996b) for the ACGIH-TLV, NIOSH-REL, and other exposure limit values.

2

MEI - maximally exposed individual of the public.

3

Hazard Quotient for MEI - boundary annual emissions/reference concentration (RfC).

4

Hazard Quotient for workers - 100-m, 8-hr emissions/permissible exposure limit (PEL).

5

Cancer risk for MEI - (emissions concentrations) x (0.286 [converts concentration to dose]) x (slope factor [SF]).

6

Cancer risk for workers - (emissions for 8-hr) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (0.286 [converts concentration to dose]) x (slope factor).

7

Hazard index - sum of individual hazard quotients.

8

Total cancer risk - sum of individual cancer risks.

OR LMES 1995e.

9

See the Chemical Health Effects Technical Reference (TTI 1996b) for the ACGIH-TLV, NIOSH-REL, and other exposure limit values.

10

MEI - maximally exposed individual of the public.

11

Hazard Quotient for MEI - boundary annual emissions/reference concentration (RfC).

12

Hazard Quotient for workers - 100-m, 8-hr emissions/permissible exposure limit (PEL).

13

Cancer risk for MEI - (emissions concentrations) x (0.286 [converts concentration to dose]) x (slope factor [SF]).

14

Cancer risk for workers - (emissions for 8-hr) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (0.286 [converts concentration to dose]) x (slope factor).

15

Hazard index - sum of individual hazard quotients.

16

Total cancer risk - sum of individual cancer risks.

OR MMES 1996j.

17

See the Chemical Health Effects Technical Reference (TTI 1996b) for the ACGIH-TLV, NIOSH-REL, and other exposure limit values.

18

MEI - maximally exposed individual of the public.

19

Hazard Quotient for MEI - boundary annual emissions/reference concentration (RfC).

20

Hazard Quotient for workers - 100-m, 8-hr emissions/permissible exposure limit (PEL).

21

Cancer risk for MEI - (emissions concentrations) x (0.286 [converts concentration to dose]) x (slope factor [SF]).

22

Cancer risk for workers - (emissions for 8-hr) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (0.286 [converts concentration to dose]) x (slope factor).

23

Hazard index - sum of individual hazard quotients.

24

Total cancer risk - sum of individual cancer risks.

OR LMES 1996i.

25

See the Chemical Health Effects Technical Reference (TTI 1996b) for the ACGIH-TLV, NIOSH-REL, and other exposure limit values.

26

MEI - maximally exposed individual of the public.

27

Hazard Quotient for MEI - boundary annual emissions/reference concentration (RfC).

28

Hazard Quotient for workers - 100-m, 8-hr emissions/permissible exposure limit (PEL).

29

Cancer risk for MEI - (emissions concentrations) x (0.286 [converts concentration to dose]) x (slope factor [SF]).

30

Cancer risk for workers - (emissions for 8-hr) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (0.286 [converts concentration to dose]) x (slope factor).

31

Hazard index - sum of individual hazard quotients.

32

Total cancer risk - sum of individual cancer risks.

SRS 1995a:2.

33

See the Chemical Health Effects Technical Reference (TTI 1996b) for the ACGIH-TLV, NIOSH-REL, and other exposure limit values.

34

MEI - maximally exposed individual of the public.

35

Hazard Quotient for MEI - boundary annual emissions/reference concentration (RfC).

36

Hazard Quotient for workers - 100-m, 8-hr emissions/permissible exposure limit (PEL).

37

Cancer risk for MEI - (emissions concentrations) x (0.286 [converts concentration to dose]) x (slope factor [SF]).

38

Cancer risk for workers - (emissions for 8-hr) x (0.237 [fraction of year exposed]) x (0.571 [fraction of lifetime working]) x (0.286 [converts concentration to dose]) x (slope factor).

39

Hazard index - sum of individual hazard quotients.

40

Total cancer risk - sum of individual cancer risks.

WSRC 1995c.