DOE/EIS-319D
August 2001

Draft Environmental Impact Statement for the

Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory

United States Department of Energy
National Nuclear Security Administration
Washington, DC 20585

COVER SHEET

Responsible Agency: United States Department of Energy (DOE)

Title: Draft Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory (TA-18 Relocation EIS)

Locations: New Mexico, Nevada, Idaho

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***Abstract*:** The National Nuclear Security Administration, a separately organized agency within DOE, is responsible for providing the Nation with nuclear weapons, ensuring the safety and reliability of those nuclear weapons, and supporting programs that reduce global nuclear proliferation. These missions are accomplished through the use of DOE's core team of highly trained nuclear experts. One of the major training facilities for DOE personnel is located at Technical Area 18 (TA-18), within the Los Alamos National Laboratory (LANL), Los Alamos, New Mexico. Principal TA-18 operational activities involve research in and the design, development, construction, and application of experiments on nuclear criticality.

Though TA-18 is judged to be secure by DOE's independent inspection office, its buildings and infrastructure are from 30 to more than 50 years old and are increasingly expensive to maintain and operate. Additionally, the TA-18 operations are located in a relatively isolated area, resulting in increasingly high costs to maintain a security Category I infrastructure. DOE wishes to maintain the important capabilities currently provided at TA-18 in a manner that reduces the long-term costs for safeguards and security. DOE proposes to accomplish this by relocating the TA-18 security Category I/II capabilities and materials to new locations.

The *TA-18 Relocation EIS* evaluates the potential direct, indirect, and cumulative environmental impacts associated with this proposed action at the following DOE sites: (1) a different site at LANL (the Preferred Alternative) at Los Alamos, New Mexico; (2) the Sandia National Laboratories/New Mexico at Albuquerque, New Mexico; (3) the Nevada Test Site near Las Vegas, Nevada; and (4) the Argonne National Laboratory-West near Idaho Falls, Idaho. The EIS also analyzes upgrading of the TA-18 facilities at LANL. As required by Council on Environmental Quality regulations, the *TA-18 Relocation EIS* also evaluates the No Action Alternative of maintaining the operations at the current TA-18 location.

Public Comments: In preparing this draft EIS, DOE considered comments received from the public during the scoping period (May 2, 2000, through June 15, 2000). Comments on this draft EIS may be submitted during the 45-day comment period. Public meetings on this EIS will be held during the comment period. The dates, times, and locations of these meetings will be published in the *Federal Register* notice announcing the availability of this draft EIS.

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ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ANL-W	Argonne National Laboratory-West
CASA	Critical Assembly Storage Area
CFR	*Code of Federal Regulations*
DAF	Device Assembly Facility
DOE	U.S. Department of Energy
EBR-II	Experimental Breeder Reactor-II
EIS	environmental impact statement
FMF	Fuel Manufacturing Facility
FR	*Federal Register*
GPEB	general-purpose experimental building
INEEL	Idaho National Engineering and Environmental Laboratory
LACEF	Los Alamos Critical Experiments Facility
LANL	Los Alamos National Laboratory
NEPA	National Environmental Policy Act
NMSF	Nuclear Material Storage Facility
NNSA	National Nuclear Security Administration
NTS	Nevada Test Site
PIDAS	Perimeter Intrusion Detection and Assessment System
SHEBA	Solution High-Energy Burst Assembly
SNL/NM	Sandia National Laboratories/New Mexico
SNM	special nuclear material(s)
SWEIS	sitewide environmental impact statement
TA	technical area
TA-18	Technical Area 18
TREAT	Transient Reactor Test Facility
ZPPR	Zero Power Physics Reactor

Metric Conversion Chart

To Convert Into Metric			*To Convert From Metric*		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092903	square meters	square meters	10.7639	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.40469	hectares	hectares	2.471	acres
square miles	2.58999	square kilometers	square kilometers	0.3861	square miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32, then multiply by 0.55556	Celsius	Celsius	Multiply by 1.8, then add 32	Fahrenheit

Metric Prefixes

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

SUMMARY

This document summarizes the U.S. Department of Energy's *Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (*TA-18 Relocation EIS*). In addition to information concerning the background, purpose and need for the proposed action, and the National Environmental Policy Act process, this summary includes the requirements for current and future Technical Area 18 missions, the alternatives and proposed relocation facilities, the Department of Energy's identified Preferred Alternative, and a comparison of environmental impacts among alternatives.

S.1 Introduction and Background

The National Nuclear Security Administration (NNSA), a separately organized agency within the U.S. Department of Energy (DOE), is responsible for providing the Nation with nuclear weapons, ensuring the safety and reliability of those nuclear weapons, and supporting programs that reduce global nuclear proliferation. These mission responsibilities are accomplished through the use of DOE's core team of highly trained nuclear experts. One of the major training facilities for DOE personnel is located at Technical Area 18 (TA-18) at the Los Alamos National Laboratory (LANL), Los Alamos, New Mexico. The principal TA-18 operation is the research in and the design, development, construction, and application of experiments on nuclear criticality.

TA-18 supports important defense, nuclear safety, and other national security mission responsibilities. The operations at TA-18 enable DOE personnel to gain knowledge and expertise in advanced nuclear technologies that support the following: (1) nuclear materials management and criticality safety; (2) emergency response in support of counterterrorism activities; (3) safeguards and arms control in support of domestic and international programs to control excess nuclear materials; and (4) criticality experiments in support of Stockpile Stewardship and other programs. The TA-18 facilities are the Nation's only facilities capable of performing general-purpose nuclear materials handling for a variety of experiments, measurements (to determine the presence of nuclear materials), and training. TA-18 also houses the Western Hemisphere's largest collection of machines for conducting nuclear safety evaluations and establishing limits for operations.

The primary operation at TA-18 is the performance of criticality experiments. Criticality experiments involve systems of fissile material(s), called critical assemblies, which are designed to reach a condition of nuclear criticality. The capability to conduct criticality experiments also includes development of nuclear instruments, measurement and evaluation of integral cross sections, accident simulation, dosimetry, and the detection and characterization of nuclear material. A critical assembly is a machine used to manipulate a mass of fissile material in a specific geometry and composition. The movement or addition of fissile material in the critical assembly can allow it to reach the condition of nuclear criticality and control the reactivity. A critical assembly is a small version (i.e., from several inches to several feet) of a nuclear power plant core. Fissile materials that can be used in a critical assembly typically consist of one of the following five main isotopes: uranium-233, uranium-235, neptunium-237, plutonium-239, or plutonium-241, in a specific composition and shape. A neutron source may be placed near the assembly to ensure that the fission rate of the critical assembly can be readily observed as it approaches and reaches criticality. The quantity of fissile material capable of sustaining such a reaction is called the critical mass for that assembly. Critical mass is

SPECIAL NUCLEAR MATERIALS SAFEGUARDS AND SECURITY
(DOE Order 474.17-1A)

Special nuclear materials (SNM) are defined in the Atomic Energy Act of 1954 as (1) plutonium, uranium enriched in the isotope 233 or 235, or any other material designated as SNM; or (2) any material artificially enriched by any of the above.

DOE's policy is to protect national security and the health and safety of DOE and contractor employees, the public, and the environment by protecting and controlling SNM. This is done by designing specific safeguards and security strategies to prevent or minimize both unauthorized access to SNM and unauthorized disclosure, loss, destruction, modification, theft, compromise, or misuse of SNM as a result of terrorism, sabotage, or events such as disasters and civil disorders.

DOE uses a cost-effective, graded approach to providing SNM safeguards and security. Quantities of SNM stored at each DOE site are categorized into security Categories I, II, III, and IV, with the greatest quantities included under security Category I and lesser quantities included in descending order under security Categories II through IV.

a function of many factors including the mass and enrichment of the fissile material; the geometry, or shape, of the assembly; and the presence of reflectors or neutron absorbers.

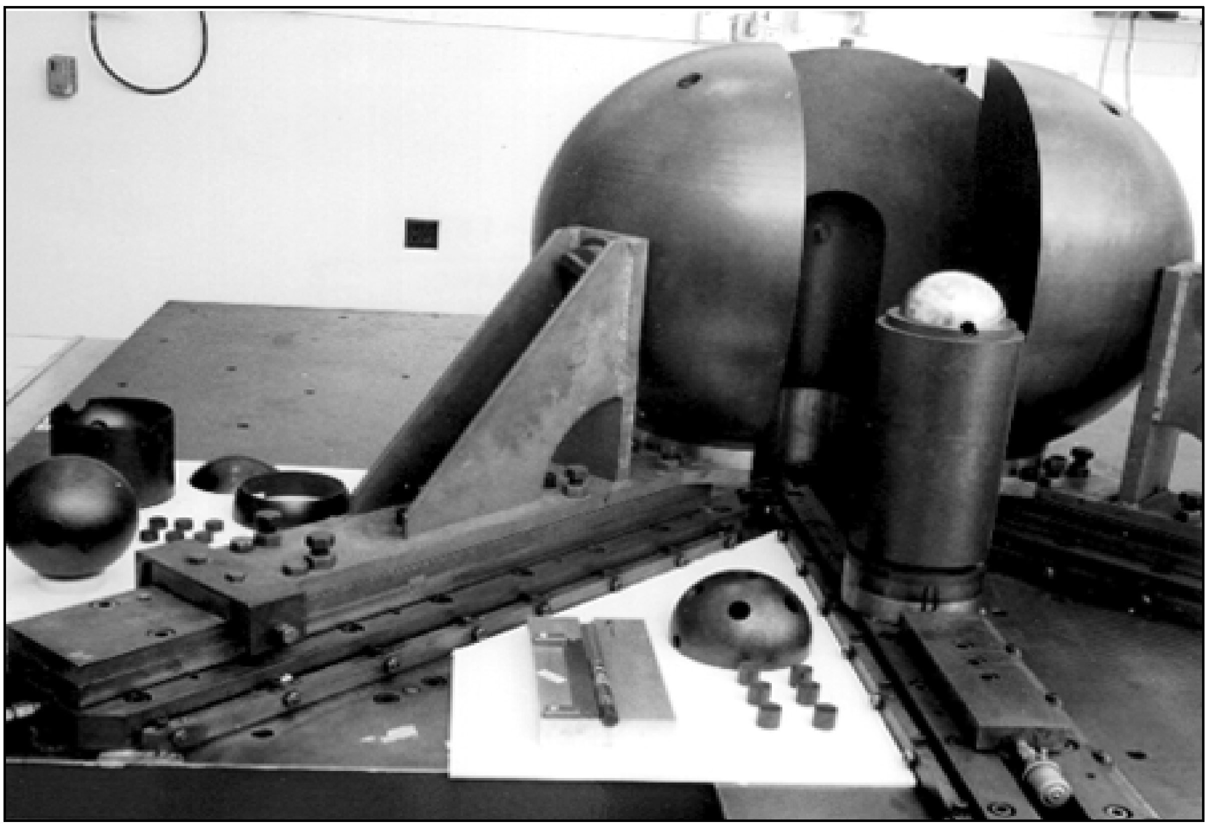
Since 1948, thousands of experiments with several fissile materials (uranium-235 and uranium-233, isotopes of plutonium, and neptunium-237) have been conducted at TA-18. These experiments have been performed with metal or compounds, both bare and reflected, as solid, liquid, and gas throughout the entire range of fast, intermediate, and thermal neutron spectra. Critical assemblies at TA-18 are designed to operate at low-to-average power and at temperatures well below the fissile material temperature operating limits (which sets them apart from normal reactors), with low fission-product production and minimal fission-product inventory. (See text box below for a discussion of a typical critical assembly.) SNM is stored in either Critical Assembly Storage Areas (CASAs) or in the Hillside vault. The onsite TA-18 nuclear material inventory is relatively stable and consists primarily of isotopes of plutonium and uranium. The bulk of the plutonium is metal and is either clad or encapsulated. The use of toxic and hazardous materials is limited.

DOE proposes to relocate the TA-18 mission operational capabilities and materials to a new location and continue to perform those mission operations at the new location for the foreseeable future (for purposes of the environmental impact statement (EIS), the operations are assessed for a 25-year operating period). As described below, the EIS evaluates four alternative locations for the proposed action as well as a TA-18 Upgrade Alternative and the No Action Alternative. The proposed action includes: transport of critical assembly machines and support equipment to a new location; modification of existing facilities to support the TA-18 missions; or construction and operation of "new" facilities for 25 years to support the TA-18 missions. Relocation of TA-18 mission operations would also include transport of up to approximately 2.4 metric tons (2.6 tons) of SNM associated with the TA-18 missions and a range of disposition options associated with the existing TA-18 facilities that would be vacated if the mission operations are relocated.

The *Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory (TA-18 Relocation EIS)* evaluates the potential direct, indirect, and cumulative environmental impacts associated with this proposed action at the following DOE sites: (1) a different site at LANL (the Preferred Alternative) at Los Alamos, New Mexico; (2) Sandia National Laboratories/New Mexico (SNL/NM) at Albuquerque, New Mexico; (3) the Nevada Test Site (NTS) near Las Vegas, Nevada; and (4) Argonne National Laboratory-West (ANL-W) near Idaho Falls, Idaho. These site alternatives were developed by a DOE-wide Option Study Group (Group) chartered to develop reasonable alternatives for the relocation of TA-18 mission operations. The Group developed criteria that screened for sites with existing security Category I infrastructure; nuclear environmental, safety, and health infrastructure; and compatibility between the site and TA-18 mission operations. The EIS also analyzes the upgrading of TA-18 facilities at LANL and the No Action Alternative.

TYPICAL CRITICAL ASSEMBLY

Critical assembly designs at TA-18 use different methods to reach a criticality condition. In some cases, additional fissile material is added in discrete quantities to an existing configuration. Other criticality assembly designs allow for a constant mass of fissile material, in two or more separate components, to be moved closer together in small increments. Some critical assembly systems incorporate movable neutron-absorbing components, which can be moved into and out of the fissile material mass to control the fission reaction. Critical assemblies can be composed of fissile materials in either solid or liquid form. For example, a critical assembly could range from a small 15-centimeter (6-inch) sphere of plutonium-239 metal with a mass of about 6 kilograms (13.2 pounds) to larger quantities of enriched uranium-235 in various shapes. An example of a critical assembly used in the TA-18 facility is the Flattop assembly, shown below. This assembly, including all of its structure, has a base of approximately 2.4 × 1.8 meters (8 × 6 feet) and a height of 1.5 meters (5 feet). The fissile material is a 15-centimeter (6-inch) sphere of enriched uranium (93 percent uranium-235) metal or plutonium-239 metal, reflected by the natural uranium hemisphere blocks.



Flattop Critical Assembly

Based on the analytical results of the EIS, as well as cost, schedule, safeguards and security issues, and other programmatic considerations which are not part of this EIS, DOE intends to make the following decisions concerning the security Category I/II, the Solution High-Energy Burst Assembly (SHEBA), and other security Category III/IV activities currently being conducted at LANL's TA-18 facilities:

- Whether to relocate the security Category I/II activities from TA-18 to a new location, or maintain these mission support operations at their current location with or without upgraded facilities. If a decision is made to relocate the security Category I/II activities, to select one of four proposed relocation sites (i.e., TA-55 at LANL, TA-V at SNL/NM, the Device Assembly Facility (DAF) at NTS, or ANL-W)

- Whether to relocate all or some of the TA-18 security Category III/IV activities to new and/or other locations at LANL (SHEBA activities to TA-39; other security Category III/IV activities to TA-55), or maintain these operations at their current location with or without upgraded facilities

The analysis in this EIS will support decision making related to eventual site-specific construction and operation activities for any alternative selected.

S.1.1 Purpose and Need for Action

Nuclear materials management is a fundamental responsibility of DOE, as its operations routinely involve the use of nuclear materials. The nuclear criticality safety, research, and training at TA-18 play a key role in ensuring that DOE handles nuclear materials in a safe manner.

The National Nuclear Security Administration is responsible for a number of activities involving the use of nuclear materials. DOE's Office of Defense Programs is responsible for maintaining the Nation's nuclear weapons program. Activities associated with this mission include handling and processing fissile materials for use in nuclear weapons and storage of special nuclear material. DOE's Emergency Response Program directly supports weapons-of-mass-destruction initiatives stemming from Executive Order 12938 and Presidential Decision Directives 39 and 62. This program is responsible for developing detection and diagnostic equipment to protect the United States against terrorist devices of unknown design and origin. Additionally, DOE's Nuclear Nonproliferation Program is responsible for developing nuclear measurement methods to verify treaty agreements with foreign nations, protect the United States against nuclear smuggling activities, and support domestic and international safeguards.

In other areas of DOE, the Environmental Management Program is responsible for cleaning up former weapons complex facilities that house surplus fissile materials in various storage arrays. The Civilian Radioactive Waste Management Program is responsible for identifying a long-term repository for high-level nuclear waste from commercial power plants. In both cases, specific information is needed on nuclear materials to determine safe storage configurations to prevent criticality events.

To carry out these missions in a safe manner, DOE needs to maintain the capability to conduct general-purpose criticality experiments and detector development with various types and configurations of special nuclear material. Additionally, DOE needs to maintain the capability to train its Federal and contractor employees to handle nuclear materials in a manner that will prevent inadvertent criticality. In 1993, and again in 1997, the Defense Nuclear Facilities Safety Board recommended that DOE continue to maintain the capability to support the TA-18 criticality experiments program.

Currently, the criticality experiments activities are conducted at a collection of facilities located at TA-18 in Los Alamos, New Mexico. TA-18 at LANL is the only DOE facility where criticality experiments routinely are performed. This collection of facilities is near the end of its useful life, and action is required by DOE to assess alternatives for continuing these activities for the next 25 years.

This EIS identifies siting options to assist DOE in determining a long-term strategy for maintaining nuclear criticality missions, infrastructure, and expertise presently residing at TA-18.

S.1.2 Scoping Process

Scoping is a process in which the public and stakeholders provide comments directly to the Federal agency on the scope of the EIS. This process is initiated by the publication of the Notice of Intent in the *Federal Register*.

On May 2, 2000, DOE published a Notice of Intent to prepare the *TA-18 Relocation EIS* (65 FR 25472). In this Notice of Intent, DOE invited public comment on the *TA-18 Relocation EIS* proposal. Subsequent to this notice, DOE held public scoping meetings in the vicinity of all sites that might be affected by the proposed action. Public scoping meetings were held as follows: (1) May 18–Albuquerque, New Mexico; (2) May 23–North Las Vegas, Nevada; (3) May 25–Idaho Falls, Idaho; and (4) May 30–Española, New Mexico (note: this public meeting was originally scheduled for May 17 at Los Alamos, New Mexico, but was rescheduled and relocated due to the Cerro Grande Fire).

All comments received, orally and in writing at these meetings, via mail, fax, the Internet, and the toll-free phone line, were reviewed for consideration by DOE in preparing the EIS.

S.1.2.1 Issues Identified During the Scoping Period

Many of the verbal and written comments received during the public scoping period identified the need for DOE to describe in detail the existing TA-18 capabilities and processes, as well as the specific requirements associated with the alternatives for fulfilling DOE's mission support needs. In particular, comments addressed the suitability of other sites to perform these mission support needs, the design of any buildings to be constructed or modified, construction and operation timelines, and controls to limit releases to the environment.

A significant number of comments also expressed concern about the costs associated with operating TA-18 criticality experiments facilities or relocating these capabilities elsewhere. These comments suggested that detailed cost analyses be conducted to analyze the construction, operation, security, and transportation needs of the various alternatives.

Many comments also addressed both the SNM needed to support, and the waste streams resulting from, TA-18 operations. Clarification was requested as to the amount of SNM that would be required under each alternative, the manner and routes of its transport, and the availability of suitable shipping containers. Waste management concerns addressed the need to identify the types and volumes of waste resulting from the proposed action; the available facilities at each site to treat, store, or dispose of the waste; the associated transportation requirements; and compatibility of the proposed action with state and Federal regulations.

Several commentors expressed concern over the environmental, health, and safety risks associated with TA-18 operations. DOE representatives were urged to thoroughly evaluate the potential consequences of the proposed action on local wildlife, water resources, and the health and safety of area residents, and to take into account the Cerro Grande Fire at LANL. Comments also suggested that the EIS quantify all radionuclide and chemical emissions resulting from the proposed action. Concerns were raised about the safety and security of the existing TA-18 facilities and how safety and security would be addressed at each of the potential relocation sites. Commentors expressed favor or opposition for a particular relocation alternative, reasons for which included security, cost, and workforce advantages.

Major issues identified through both internal DOE and public scoping are addressed in the EIS by analyses in the following areas:

- Land resources, including land use and visual resources
- Site infrastructure
- Air quality and acoustics
- Water resources, including surface water and groundwater
- Geology and soils
- Biotic resources, including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species
- Cultural and paleontological resources, including prehistoric resources, historic resources, and Native American resources
- Socioeconomics, including regional economic characteristics, demographic characteristics, housing and community services, and local transportation
- Radiological and hazardous chemical impacts during normal operations and accidents
- Waste management
- Transportation of nuclear materials

In addition to analyses in these areas, the EIS also addresses monitoring and mitigation, unavoidable impacts and irreversible and irretrievable commitment of resources, and impacts of long-term productivity.

S.1.2.2 Relationships to Other Actions and Programs

This section explains the relationship between the *TA-18 Relocation EIS* and other relevant National Environmental Policy Act (NEPA) documents and DOE programs. Completed NEPA compliance actions are addressed in Section S.1.2.2.1; ongoing actions are discussed in Section S.1.2.2.2.

S.1.2.2.1 Completed NEPA Compliance Actions

Final Environmental Assessment for Device Assembly Facility Operations (DOE/EA-0971)—The *Final Environmental Assessment for Device Assembly Operations* was issued in May 1995 and evaluates the proposed action to operate DAF at NTS. DAF is one of the facilities considered under the proposed action to receive relocated TA-18 activities.

Environmental Assessment for Consolidation of Certain Materials and Machines for Nuclear Criticality Experiments and Training – Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/EA-1104)—In May 1996, DOE issued the Environmental Assessment and Finding of No Significant Impact for *Consolidation of Certain Materials and Machines for Nuclear Criticality Experiments and Training – Los Alamos National Laboratory*. This environmental assessment compared the effects of consolidating nuclear criticality experiments machines and materials at the Los Alamos Critical Experiments Facility (LACEF) at LANL's TA-18. Actions consolidated through this environmental assessment resulted in the program which exists today and form the basis for the No Action Alternative presented in the *TA-18 Relocation EIS*.

Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement (DOE/EIS-0240)—the *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* was issued in June 1996. DOE prepared this EIS because of the need to move rapidly to neutralize the proliferation threat of surplus highly enriched uranium and to demonstrate the United States' commitment to nonproliferation. It evaluated management alternatives for materials used by TA-18 activities.

Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (DOE/EIS-0243)—The *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* was issued in August 1996. The Record of Decision was published in December 1996. The proposed action to relocate the TA-18 capabilities and materials is consistent with the decisions documented in the Record of Decision.

Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management (DOE/EIS-0236)—In September 1996, DOE issued the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*. This programmatic EIS evaluated the potential environmental impacts resulting from activities associated with nuclear weapons' research, design, development, and testing, as well as the assessment and certification of the weapons' safety and reliability. The Record of Decision was published in December 1996. Criticality experiments at TA-18 support the stockpile stewardship mission addressed in this programmatic EIS.

Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory (DOE/EIS-0238)—The *Final Site-Wide EIS for Continued Operation of LANL* (*LANL SWEIS*) was issued in January 1999. In the September 1999 Record of Decision, DOE selected the Expanded Operations Alternative. The No Action Alternative assessed in the *TA-18 Relocation EIS* is consistent with the Preferred Alternative chosen through the *LANL SWEIS* Record of Decision.

Idaho National Engineering and Environmental Laboratory Advanced Mixed Waste Treatment Project Final Environmental Impact Statement (DOE/EIS-0290)—The *Idaho National Engineering and Environmental Laboratory Advanced Mixed Waste Treatment Project Final Environmental Impact Statement* was issued in March 1999. The Record of Decision was published in the *Federal Register* on April, 1999 (64 FR 16948). The impacts of the action DOE decided to implement are factored into the assessment of potential cumulative impacts discussed in the *TA-18 Relocation EIS* proposed action.

Final Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico (DOE/EIS-0281)—The *Final Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico* (*SNL/NM SWEIS*) was issued in October 1999. The Record of Decision for the *SNL/NM SWEIS* was published in the *Federal Register* on December 15, 1999 (64 FR 69996). The proposed action to relocate the TA-18 capabilities and materials is consistent with the decision documented in the *SNL/NM SWEIS* Record of Decision.

Surplus Plutonium Disposition Final Environmental Impact Statement (DOE/EIS-0283)—The *Surplus Plutonium Disposition Final Environmental Impact Statement* was issued in November 1999. The Record of Decision for the programmatic EIS, published in the *Federal Register* on January 14, 1997 (62 FR 3014), outlined DOE's approach to plutonium disposition and established the groundwork for the *Surplus Plutonium Disposition EIS*. In the Record of Decision, published in the *Federal Register* on January 11, 2000 (65 FR 1608), DOE decided to provide for the safe and secure disposition of up to 50 metric tons of surplus plutonium as mixed oxide fuel and through immobilization. Plutonium used in support of TA-18 activities could be dispositioned, when necessary, using material management methods described in the *Surplus Plutonium Disposition EIS*.

Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel (DOE/EIS-0306)—The *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* was issued in July 2000. The Record of Decision was published in the *Federal Register* on September 19, 2000 (65 FR 56565). The proposed action under this EIS contributes to the cumulative impacts at the site discussed in the *TA-18 Relocation EIS*.

Special Environmental Analysis for the Department of Energy, National Nuclear Security Administration: Actions Taken in Response to the Cerro Grande Fire at Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/SEA-03)—In September 2000, DOE and NNSA issued this special environmental analysis to document their assessment of impacts associated with emergency activities conducted at LANL, Los Alamos County, New Mexico, in response to major disaster conditions caused by the recent Cerro Grande Fire. These emergency activities included activities taken at TA-18 that altered the TA-18 setting as discussed in the *TA-18 Relocation EIS*.

Environmental Assessment for the Microsystems and Engineering Sciences Applications Complex (DOE/EA-1335)—The *Environmental Assessment for the Microsystems and Engineering Sciences Applications Complex* was issued in September 2000 and analyzed the potential effects of constructing several new facilities and upgrading existing facilities at SNL/NM. A Finding of No Significant Impact was signed on October 16, 2000. The impacts of this action are factored into the assessment of potential cumulative impacts at SNL/NM in the *TA-18 Relocation EIS*.

Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility (Nuclear Infrastructure Programmatic EIS) (DOE/EIS-0310)—The *Final Nuclear Infrastructure Programmatic EIS* was issued in December 2000. The Record of Decision was published in the *Federal Register* on January 26, 2001 (66 FR 7877). Through the Record of Decision, DOE selected the Preferred Alternative, under which DOE will reestablish domestic production of plutonium-238, as needed, using the Advanced Test Reactor at the Idaho National Engineering and Environmental Laboratory (INEEL) in Idaho and the High Flux Isotope Reactor at Oak Ridge National Laboratory in Tennessee. The impacts of this action are factored into the assessment of potential cumulative impacts at INEEL in the *TA-18 Relocation EIS*.

Final Environmental Assessment for Atlas Relocation and Operation at the Nevada Test Site (DOE/EA-1381)—In May 2001, DOE issued the *Final Environmental Assessment for Atlas Relocation and Operation at the Nevada Test Site*. This document assesses the environmental impacts of DOE's proposed action to disassemble the Atlas pulsed-power machine at LANL and transport it to NTS, where it would be reassembled in a new building in Area 6 north of DAF. The potential effects of this action are factored into the assessment of potential cumulative impacts resulting from the *TA-18 Relocation EIS* proposed action.

S.1.2.2.2 Ongoing NEPA Compliance Actions

Draft Idaho High-Level Waste and Facilities Disposition Environmental Impact Statement (DOE/EIS-0287)—The *Draft Idaho High-Level Waste and Facilities Disposition Environmental Impact Statement* was issued in December 1999. It evaluates alternatives for managing the high-level radioactive waste and associated radioactive waste and facilities at INEEL. The proposed action under this EIS contributes to the cumulative impacts at INEEL discussed in the *TA-18 Relocation EIS*.

Sandia Underground Reactor Facility Environmental Assessment—DOE is in the process of preparing an environmental assessment for construction and operation of the Sandia Underground Reactor Facility an underground facility designed for housing the Sandia Pulsed Reactor and other possible missions at TA-V[1], should they be relocated to SNL/NM. If implemented, the construction and operation of this facility would parallel the construction and operation of the facility proposed for the TA-18 missions.

Relationships to Other LANL Projects—DOE routinely conducts planning activities at its sites to identify long-term strategies and options for maintaining infrastructure in support of various missions. As part of these efforts, potential projects or actions are identified as options for future consideration. Many of these projects never go beyond the initial planning phases due to various factors such as insufficient justification or inadequate funding.

DOE has initiated a planning effort that focuses on the long-term strategy for conducting security Category I nuclear operations at LANL. Security Category I nuclear operations at TA-18 are discussed in Section S.1. While proposals regarding TA-18 activities may fall within the scope of this plan, along with other activities such as analytical chemistry, security, and pit manufacturing, DOE has determined that the TA-18 Relocation proposal must move forward independent of this broader planning effort to ensure continuous mission support. Many of the activities in this planning effort are in the preliminary phase of consideration and the effort is too speculative at the present time for NEPA analysis. To the extent sufficient information is available, this draft EIS discusses the potential cumulative impacts from other reasonably foreseeable activities at LANL.

S.2 PROJECT OPERATIONS AND REQUIREMENTS

DOE intends to continue to perform TA-18 mission operations. The mission operations, therefore, as well as the requirements to fulfill them at a new location, are those identified by current activities at TA-18 and are described below.

S.2.1 Operations

TA-18 personnel perform general-purpose nuclear materials handling, experiments, and training, including the construction and operation of high-multiplication devices, delayed critical devices, and prompt critical devices. The operational capabilities located at TA-18 enable DOE personnel to gain knowledge and expertise in advanced nuclear technologies that support the following areas:

- Nuclear Materials Management and Criticality Safety
- Emergency Response
- Nonproliferation and Safeguards and Arms Control
- Stewardship Science

Nuclear Materials Management and Criticality Safety

The objective of nuclear materials management and criticality safety activities is to ensure that fissile material is handled so that it remains subcritical under both normal and credible abnormal conditions to protect workers, the public, and the environment. This objective is relevant to all DOE programs that are responsible for safely managing SNM. The following activities would be required to support nuclear materials management and criticality safety:

- performance of experiments to support safety evaluations for nuclear material process operations

[1] *Technical areas at SNL/NM are designated using roman numerals rather than the arabic numerals used at LANL.*

- testing and qualifying equipment and systems used to ensure nuclear criticality safety
- conducting experiments to better understand criticality impacts of nuclear materials in new physical situations
- maintaining the capability and expertise of DOE's nuclear criticality safety engineers and those who have criticality-safety-related responsibilities

Emergency Response

The Emergency Response Program elements conducted at TA-18 would include the following activities:

- training, drills, experiments, and technology development activities for emergency response personnel
- constructing mock-ups of realistic weapons designs to test, develop, and validate detection equipment and methods to maintain emergency response capabilities
- using nuclear material to conduct criticality experiments to avoid technological surprises

Nonproliferation and Safeguards and Arms Control

Operations at TA-18 have already played a pivotal role in the development of verification technology for the Strategic Arms Reduction Treaty I and Intermediate-Range Nuclear Forces Agreements. Additionally, TA-18 operational capabilities provide ongoing training of inspectors and development of safeguards technology for the International Atomic Energy Agency. The following activities would be performed to support the nuclear nonproliferation and safeguards and arms control:

- supporting development and testing of technologies for conducting nuclear measurements for verification or transparency of declarations concerning nuclear weapons
- developing and evaluating new technologies for conducting nuclear measurements to determine the presence of nuclear materials
- conducting training of law enforcement and emergency response personnel using nuclear materials in realistic settings
- providing independent assessment of other Federal agencies' technologies to assist in the selection of emergency response capabilities.

Stewardship Science

Stockpile stewardship is a principal mission responsibility of the NNSA, pursuant to national policy, presidential directives, and public law. A major element of this mission responsibility is the development and application of scientific and technical capabilities to assure the continued safety and reliability of U.S. nuclear weapons in the absence of underground nuclear testing.

S.2.2 Facilities, Personnel, and Materials Requirements

A diverse team sponsored by the DOE Office of Defense Programs was selected to review DOE's mission requirements presently supported at LANL's TA-18. This review encompassed all past, current, and any envisioned mission requirements, including all of the operational capabilities identified above. The team was tasked with recommending needed facilities, as well as requirements for special experimental equipment, personnel, and materials to support the operational capabilities and materials supported at TA-18.

Three subteams for the major mission requirements (Nuclear Materials Management and Criticality Safety, Emergency Response, and Nonproliferation and Safeguards and Arms Control) were established. The subteams were responsible for providing input for the report that delineates the facility, equipment, personnel, and material requirements to support planned and projected mission requirement workloads.

The TA-18 mission requirements review team reached consensus on the required facilities, equipment, personnel, and materials necessary to support the operational capabilities deemed necessary. The requirements are detailed in the project's *Functional and Operational Requirements Document* and are briefly discussed below.

Facilities and Equipment

The facilities needed to support current and future DOE mission requirements and TA-18 operational capabilities would consist of security Category I SNM experimental bays with control rooms for critical assembly machines, SNM storage vaults, waste storage areas, SNM shipping and receiving areas, a low-scatter facility, a radiography bay, office space, conference rooms, training facilities, access control areas, change-room facilities, a machine shop, an electronics fabrication shop, and other facilities necessary to meet the requirements for the safe handling of nuclear materials.

Four security Category I/II SNM critical assembly machines are required to support ongoing TA-18 operational capability requirements. These machines, discussed below, would be refurbished or replaced and relocated from TA-18 if a relocation alternative is selected.

- A general-purpose vertical-lift table machine for training and initial assembly of new experiments. Vertical-lift machines are ideal for this purpose because the stored energy for disassembly is provided by gravity. At the present time, the Planet machine provides this function.

- A fast-neutron-spectrum benchmarked assembly for validation of calculational methods, basic measurements of nuclear data of interest to defense and nuclear nonproliferation programs, and training. At the present time, the Flattop assembly serves this purpose.

- A pulse assembly to validate dynamic weapons models, verify the function of criticality alarm systems to a fast transient, calibrate detectors, and validate radiation dosimetry. The Godiva assembly provides this function at the present time. The Godiva assembly is particularly appropriate for the validation of dosimetry.

- A large-capacity, general-purpose vertical table machine to accommodate benchmark experiments designed to explore unknowns. The Comet machine at TA-18 is currently used for this purpose. It is presently stacked with a massive assembly to evaluate intermediate neutron spectra for the first time.

The current operations at TA-18 are also supported by SHEBA, a low-enriched uranium-solution critical assembly security Category IV SNM machine. It provides capabilities for free-field irradiation of criticality alarm systems and dosimetry validation. The SHEBA activities relocation under the various alternatives is discussed in detail in the EIS.

Personnel

Technical staff are needed (including physicists, engineers, and technicians) to perform existing TA-18 and new-facility mission support functions. These personnel require significant unique experience in nuclear criticality safety experiments and nuclear materials handling; neutron, gamma, and x-ray measurements; nuclear instrumentation design; and real-time radiography. Additionally, the personnel need significant experience in hazard Category 2, security Category I/II SNM nuclear facility operations, authorization-basis development and maintenance, and quality assurance. Also, a number of other support personnel, including safeguards-and-security-knowledgeable personnel, are needed to implement the security requirements for the protection of SNM.

Materials

The current inventory of nuclear material at TA-18 consists of approximately 2.8 metric tons (3.1 tons) of security Category I SNM and 18.5 metric tons (20 tons) of depleted and natural uranium and thorium. However, as a result of a concerted effort to reduce unnecessary site inventory, the forecasted mission support need would be to accommodate approximately 2.4 metric tons (2.6 tons) of security Category I SNM and 10 metric tons (11 tons) of depleted natural uranium and thorium (which do not require special security arrangements). The SNM inventory would consist of uranium in various forms and enrichments and plutonium (mostly metals, double-encapsulated or clad), with a wide variety of contents including plutonium-240, uranium-233, neptunium-237, thorium, and other isotopic sources.

S.3 DEVELOPMENT OF REASONABLE ALTERNATIVES

The *TA-18 Relocation EIS* evaluates the environmental impacts associated with the proposed action of relocating TA-18 capabilities and materials associated with security Category I/II activities to a new location. Location alternatives include the following DOE sites: (1) a different site at LANL at Los Alamos, New Mexico; (2) SNL/NM at Albuquerque, New Mexico; (3) NTS near Las Vegas, Nevada; and (4) ANL-W near Idaho Falls, Idaho. These site alternatives were developed by a Department-wide Option Study Group chartered to develop reasonable alternatives for the relocation of TA-18 operations. Criteria were developed that screened for sites with existing security Category I/II infrastructure; nuclear environmental, safety, and health infrastructure; and compatibility between the site and TA-18 operational capabilities. In conjunction with the relocation of security Category I/II activities the EIS also evaluates the environmental impacts associated with the relocation of TA-18 security Category III/IV activities within LANL. The alternatives evaluated in the EIS are as follows:

<u>TA-18 Upgrade Alternative</u>—This alternative would involve upgrading the buildings, infrastructure and security infrastructure of the existing TA-18 facilities to continue housing these TA-18 operations at their present location at LANL. Under this alternative, some construction activities would be necessary.

<u>LANL New Facility Alternative</u>—This alternative would involve housing the security Category I/II activities in a new building to be constructed near the Plutonium Facility 4 at TA-55. Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at TA-39 or remain at TA-18; the rest of the security Category III/IV activities would either be relocated to a new structure at TA-55 or remain at TA-18.

<u>SNL/NM Alternative</u>—This alternative would involve the housing of the security Category I/II TA-18 operations within a new security Category I/II facility within TA-V at SNL/NM. Currently, SNL/NM operates a variety of research-oriented nuclear facilities at TA-V. A new underground facility and modifications to existing buildings would be required. Under this alternative, a portion of the security

Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at LANL's TA-39 or remain at TA-18; the rest of the security Category III/IV activities would remain at TA-18.

NTS Alternative—This alternative would involve the housing of the security Category I/II TA-18 operations in and around the existing DAF. Currently, DAF is used for the assembly of subcritical assemblies, as well as other miscellaneous national security missions. Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at LANL's TA-39 or remain at TA-18; the rest of the security Category III/IV activities would remain at TA-18.

ANL-W Alternative—This alternative would involve the housing of the security Category I/II TA-18 operations in the existing Fuel Manufacturing Facility (FMF) and other existing buildings at ANL-W. New construction to expand the existing FMF would be required to accommodate the TA-18 operations. Security upgrades would also be necessary. Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at LANL's TA-39 or remain at TA-18; the rest of the security Category III/IV activities would remain at TA-18.

No Action Alternative—As required by Council on Environmental Quality regulations, the *TA-18 Relocation EIS* includes the No Action Alternative of maintaining the TA-18 operations at the current location. This alternative would maintain the current missions at TA-18 as described in the Expanded Operations Alternative of the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory (LANL SWEIS)* and the associated Record of Decision (64 FR 50797). No upgrades or alternatives of either building, infrastructure or security infrastructure would occur.

Table S–1 illustrates the proposed relocation sites for the TA-18 capabilities and materials.

Table S–1 Proposed Relocation Sites for TA-18 Capabilities and Materials

Activities	*No Action Alternative*	*TA-18 Upgrade Alternative*	*LANL New Facility Alternative*	*SNL/NM Alternative*	*NTS Alternative*	*ANL-W Alternative*
Security Category I/II	TA-18	TA-18	TA-55	TA-V	DAF	FMF/ZPPR
SHEBA (Security Category IV)	TA-18	TA-18	TA-39 or TA-18	TA-39 or TA-18	TA-39 or TA-18	TA-39 or TA-18
Other Security Category III/IV	TA-18	TA-18	TA-55 or TA-18	TA-18	TA-18	TA-18

ZPPR = Zero Power Physics Reactor.

S.3.1 Planning Assumptions and Basis for Analysis

For the *TA-18 Relocation EIS* alternatives, the EIS evaluates relocating the operations currently performed at LANL's TA-18 to one of four alternative locations. The EIS evaluates the direct, indirect, and cumulative impacts associated with (1) the relocation of criticality operational capabilities and support equipment to each of the four alternative locations; (2) the relocation of some of the inventory of nuclear materials currently stored at TA-18 to each of the four alternative locations; (3) the construction of new or the modification of existing facilities to accommodate the security Category I/II activities at each of the alternative locations; and (4) the operation of the new or existing facility(s) for a 25-year duration. The EIS also discusses in a generic and qualitative manner the eventual decontamination and decommissioning of any new facility proposed for construction and the disposition of TA-18 buildings, infrastructure, and surplus equipment after the proposed relocation. In addition, the EIS evaluates the environmental impacts associated with the continuation of the operations at TA-18 by upgrading the existing TA-18 facilities (TA-18 Upgrade Alternative) and the relocation of SHEBA and other security Category III/IV activities, currently performed at TA-18, to another location(s) within LANL. Some of the more specific assumptions and considerations that form the bases of the analyses and impact assessments that are the subject of the EIS are presented below.

- As required by the Council on Environmental Quality regulations, the *TA-18 Relocation EIS* evaluates a No Action Alternative for comparison purposes. The No Action Alternative, which currently supports mission requirements at TA-18, may limit DOE's ability to support future DOE mission requirements unless significant upgrades to TA-18 infrastructure are accomplished.

- TA-18 operations consist of security Category I/II activities, as well as security Category III/IV activities. Security concerns regarding the relocation of TA-18 mission operations primarily involve security Category I/II activities. Relocating the TA-18 security Category I/II activities to a new location within an existing security Category I/II area has the potential to reduce life-cycle costs and improve safeguards and security. While there are no similar security concerns involving security Category III/IV activities, existing infrastructure problems at TA-18 necessitate addressing the relocation of these activities in conjunction with the relocation of security Category I/II activities. The separate treatment of the relocation of TA-18 activities in terms of security categories is reflected in the presentation of the alternatives as discussed in Section S.3.2.

- The projected start dates and estimated duration of modifications and construction for each alternative vary with each site. The periods fall in the range of 2 to 3 years. For the purpose of the analysis, it was assumed that construction under any of the alternatives would start sometime in 2004 to 2005 and would be completed by sometime in 2007 to 2008, for a construction period of 3 years. Operations would start in 2008. In accordance with the *Functional and Operational Requirements Document*, the TA-18 replacement facility subsystems and components (including criticality experiments machines) would be designed for a service life of at least 25 years. Therefore, the EIS assesses the environmental impacts associated with the operation of the existing or new facilities for a period of 25 years, at which time the structures would undergo decontamination and decommissioning.

- The new buildings proposed for the relocation of the TA-18 capabilities and materials are in a preliminary design stage. Therefore, they are not described in detail in the EIS. However, for the purpose of the environmental impact analysis, conservative assumptions have been used such that construction requirements and operational characteristics of these buildings would maximize the environmental impacts. Thus, the potential impacts from the implementation of the finalized-design alternatives would be less severe than those analyzed in this EIS.

- Of the critical assembly machines proposed for relocation, Comet, Planet, and Flattop are over 40 years old, and extensive refurbishment or replacement of these machines would be required before continuing their missions. Godiva is slightly more modern, and many of its subsystems have been recently upgraded.

  Flattop would be rebuilt using the original uranium parts; all other parts would be new. A new smaller table would be built with separated hydraulics and electrical components, simplified and more accessible control rod drives, and a modern control system. The refurbishment is expected to have minimal environmental impacts, and its operational characteristics would remain the same. The old table, electrical racks, and hydraulic systems would be disposed of as low-level radioactive waste. The waste stream would be less than 4.6 metric tons (5 tons) of low-level radioactive waste. There is a potential that lead-based paint may have been used on the table, which would result in part of the waste stream being characterized as mixed radioactive waste.

The two general assembly machines (Comet and Planet) would be moved, one at a time, to the new facility in a staged transition. This would require building a new machine stand and control assembly. A second control cartridge and stand would be manufactured, and the second machine would then be moved and brought into service. The waste stream would include two control cartridges and two machine stands and would be less than 0.9 metric tons (1 ton) of low-level radioactive waste each. The machine stands may potentially have lead-based paint on them due to the formulation of most paints at the time the stands were painted.

The Godiva stand would be used as is. It would be defueled before shipment and reassembled at the final destination. Most of the hydraulic and air systems have been refurbished recently. The 110-volt alternating-current control system would be replaced by a 24-volt direct-current control system. Some of the limit switches and wiring would be refurbished. The waste stream would be minimal and would be mostly low-level radioactive waste.

- Unique technical knowledge and experience in nuclear criticality is necessary to maintain TA-18 operational capabilities and to fulfill programmatic requirements. The expertise required to perform each mission set overlaps certain key skills such that many of the technical experts work in two or more major programmatic areas and, therefore, cannot easily be separated. Additionally, TA-18 technical personnel interact routinely with multiple organizations in LANL to collaborate on research and development issues involving weapon design and detector technology.

  To capitalize on this synergy, DOE has determined that LANL will retain responsibility for the TA-18 missions, regardless of the final location for security Category I/II operations. If a location other than LANL were selected for security Category I/II operations, LANL personnel will continue to maintain responsibility for those missions. Under this scenario, it is likely that security Category I/II operations would be conducted in a campaign mode with LANL personnel traveling to the new location on a temporary basis to conduct experiments. In addition, up to 20 support and operations personnel may be permanently relocated. To minimize programmatic impacts to TA-18 missions, DOE proposes that security Category III/IV operations remain at LANL so that TA-18 personnel can continue to routinely collaborate with other experts in a research and development environment.

- Proven technology is used as a baseline. No credit is taken for emerging technology improvements.

- The core set of accident scenarios selected from the LANL *Basis for Interim Operations for the Los Alamos Critical Experiments Facility (LACEF) and Hillside Vault (PL-26)* are applicable to each relocation alternative with adjustments to certain parameter values (e.g., leak path factors and materials at risk) to reflect site-specific features. Added to the core set of accidents are other site-specific accidents, if any, caused by natural phenomena or accidents at collocated facilities, that have the potential for initiating accidents at the relocated TA-18 facilities. The impacts of accidents analyzed for each alternative reflect and bound the impacts of all reasonably foreseeable accidents that could occur if the alternative were implemented.

- Decontamination and decommissioning of facilities as a result of the proposed action pertains to two distinct areas: (1) decontamination and decommissioning of the existing TA-18 facilities if all current operations and materials are relocated and no other program support personnel use the vacated facilities, and (2) decontamination and decommissioning of existing or new relocation facilities at the end of the 25-year proposed operation period. At the present time, the ultimate disposition of either the existing TA-18 structures or the proposed equipment for relocation and its associated new structures is not known. However, the current condition and contamination history of the TA-18 facilities and the projected use of the alternative facilities allows a qualitative assessment of the nature and extent of decontamination that would be required to allow the facilities to be released for unrestricted use.

- The relocation of the operational capabilities associated with security Category I/II activities from TA-18 would require transportation of the critical assembly machines as well as the security Category I SNM currently stored at TA-18 to the relocation site. This includes the transportation of up to approximately 2.4 metric tons (2.6 tons) of SNM to the relocation sites. Any nuclear material currently at TA-18 not deemed needed for future missions would be dispositioned through normal channels by DOE and LANL in accordance with previously prepared or future NEPA documents.

- The current operational characteristics of the critical assembly machines form the basis for the impact analysis at all other locations. These characteristics, based on the current operation of TA-18 facilities as described in the *LANL SWEIS*, are presented in **Table S–2** and discussed briefly below.

Table S–2 Operational Characteristics at TA-18

Electricity usage	2,836 megawatt-hours per year
Water usage	14.6 million liters per year
Nonradiological gaseous effluent	None
Radiological gaseous effluent	10 curies per year, argon-41 (Godiva); 100 curies per year, argon-41 (SHEBA)
Nonradiological liquid effluent	None
Radiological liquid effluent	None
Chemical effluent	None
Workforce	212 workers
Worker dose	21 person-rem per year, based on 212 workers
Waste generation	
- High-level radioactive waste	None
- Transuranic waste	None
- Low-level radioactive waste	145 cubic meters per year
- Mixed low-level radioactive waste	Less than 2 cubic meters per year
- Chemical waste (RCRA/TSCA waste)	4,000 kilograms per year
- Sanitary waste	14.6 million liters per year

RCRA = Resource Conservation and Recovery Act; TSCA = Toxic Substances Control Act.

Infrastructure Parameters—Activities associated with the operations at TA-18 are not energy- or water-use intensive. Electricity and water use at TA-18 are a small fraction of the site-wide use and would continue to be small fractions in all proposed relocation sites. There is limited use of natural gas and propane at TA-18.

Nonradiological Effluent—Criticality experiments and supporting activities do not involve nonradiological effluent in either gaseous or liquid form. However, diesel generators may be used as a source of emergency power at new locations. Emissions from diesel generator operation are included in the environmental analysis.

Radiological Effluent—The critical assemblies are designed to operate at low power and at temperatures well below phase-change transition temperatures. They do not generate significant radiological inventory of long-lived fission products and do not require forced convection cooling. Therefore, air-activation products, produced by interactions with the air outside of critical assemblies, are the primary source of air emissions.

Among the critical assemblies in TA-18, those intended for prompt critical operation, namely the Godiva assembly and SHEBA, are the major source of air-activation products. The Godiva assembly, in the past, was frequently operated outside of the remote-controlled CASA that houses it. This practice would not be continued if the activities are relocated. SHEBA, which is housed in a small weather-proof building that provides no shielding, is the major contributor to the air-activation products. The Planet, Comet, and Flattop assemblies run at lower-power levels (low fission rates) and operate inside the building, which reduces the air-activation products.

The air-activation products are generated from neutron interaction with air molecules containing argon, nitrogen, and oxygen. The radionuclide of greatest concern is argon-41, due to its 1.82-hour half-life and relatively large neutron-absorption cross section.

Air-activation products from neutron interaction generated during the operation of SHEBA and the Godiva assembly (assumed to be operating outside of CASA 3) were estimated assuming a 120-meter (394-foot) hemisphere of air surrounding each critical assembly. Although future operations of Godiva would not take place outside, if relocated, argon-41 generation from the Godiva assembly operations is conservatively assumed to be 10 curies per year. Argon-41 generation from SHEBA operations is assumed to be 100 curies per year. There is no argon-41 generation from the operation of the other critical assemblies.

Chemical Effluent—Criticality experiments and supporting activities do not involve the normal release of any chemicals in a gaseous or liquid form.

Worker Dose—The total annual dose to workers at TA-18 was estimated to be 21 person-rem for 212 workers. This corresponds to an average of 0.1 rem per worker per year, which was assumed to be the single worker annual dose from routine operations.

Workforce—The workforce at TA-18 is approximately 200. For the purpose of estimating total worker dose, the workforce at sites other than TA-18 was assumed to be 100 (excludes personnel for security Category III/IV activities). For the purpose of assessing socioeconomic effects, it was assumed that up to 20 persons would relocate permanently away from LANL, should a site other than LANL be selected.

Waste Generation—Criticality experiments and supporting activities involve some generation of low-level radioactive waste, primarily consisting of personnel protective equipment, wipes and rags. They also involve the generation of small quantities of mixed low-level radioactive waste consisting of machine shop scraps, solvents, and wipes. No high-level radioactive or transuranic waste is generated. The operations involve the generation of about 4,000 kilograms (8,800 pounds) of hazardous chemical solids annually from chemicals and solvents used during support activities. Also, nonhazardous wastes are generated (such as office paper and other debris).

S.3.2 Alternatives Evaluated

S.3.2.1 No Action Alternative

As required by Council on Environmental Quality regulations, the *TA-18 Relocation EIS* evaluates the No Action Alternative of maintaining the operations and materials at the current TA-18 location. Under the No Action Alternative, current operational capabilities and materials at TA-18 would be maintained as described in the Expanded Operations Alternative of the *LANL SWEIS* and associated Record of Decision (64 FR 50797). The No Action Alternative may limit DOE's ability to support future DOE mission support requirements unless significant upgrades to the TA-18 infrastructure are accomplished.

DOE/EIS-319D
August 2001

Draft Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory

United States Department of Energy
National Nuclear Security Administration
Washington, DC 20585

COVER SHEET

Responsible Agency: United States Department of Energy (DOE)

Title: Draft Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory (TA-18 Relocation EIS)

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***Abstract*:** The National Nuclear Security Administration, a separately organized agency within DOE, is responsible for providing the Nation with nuclear weapons, ensuring the safety and reliability of those nuclear weapons, and supporting programs that reduce global nuclear proliferation. These missions are accomplished through the use of DOE's core team of highly trained nuclear experts. One of the major training facilities for DOE personnel is located at Technical Area 18 (TA-18), within the Los Alamos National Laboratory (LANL), Los Alamos, New Mexico. Principal TA-18 operational activities involve research in and the design, development, construction, and application of experiments on nuclear criticality.

Though TA-18 is judged to be secure by DOE's independent inspection office, its buildings and infrastructure are from 30 to more than 50 years old and are increasingly expensive to maintain and operate. Additionally, the TA-18 operations are located in a relatively isolated area, resulting in increasingly high costs to maintain a security Category I infrastructure. DOE wishes to maintain the important capabilities currently provided at TA-18 in a manner that reduces the long-term costs for safeguards and security. DOE proposes to accomplish this by relocating the TA-18 security Category I/II capabilities and materials to new locations.

The *TA-18 Relocation EIS* evaluates the potential direct, indirect, and cumulative environmental impacts associated with this proposed action at the following DOE sites: (1) a different site at LANL (the Preferred Alternative) at Los Alamos, New Mexico; (2) the Sandia National Laboratories/New Mexico at Albuquerque, New Mexico; (3) the Nevada Test Site near Las Vegas, Nevada; and (4) the Argonne National Laboratory-West near Idaho Falls, Idaho. The EIS also analyzes upgrading of the TA-18 facilities at LANL. As required by Council on Environmental Quality regulations, the *TA-18 Relocation EIS* also evaluates the No Action Alternative of maintaining the operations at the current TA-18 location.

Public Comments: In preparing this draft EIS, DOE considered comments received from the public during the scoping period (May 2, 2000, through June 15, 2000). Comments on this draft EIS may be submitted during the 45-day comment period. Public meetings on this EIS will be held during the comment period. The dates, times, and locations of these meetings will be published in the *Federal Register* notice announcing the availability of this draft EIS.

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Acronyms, Abbreviations, and Conversion Charts

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ANL-W	Argonne National Laboratory-West
CASA	Critical Assembly Storage Area
CFR	*Code of Federal Regulations*
DAF	Device Assembly Facility
DOE	U.S. Department of Energy
EBR-II	Experimental Breeder Reactor-II
EIS	environmental impact statement
FMF	Fuel Manufacturing Facility
FR	*Federal Register*
GPEB	general-purpose experimental building
INEEL	Idaho National Engineering and Environmental Laboratory
LACEF	Los Alamos Critical Experiments Facility
LANL	Los Alamos National Laboratory
NEPA	National Environmental Policy Act
NMSF	Nuclear Material Storage Facility
NNSA	National Nuclear Security Administration
NTS	Nevada Test Site
PIDAS	Perimeter Intrusion Detection and Assessment System
SHEBA	Solution High-Energy Burst Assembly
SNL/NM	Sandia National Laboratories/New Mexico
SNM	special nuclear material(s)
SWEIS	sitewide environmental impact statement
TA	technical area
TA-18	Technical Area 18
TREAT	Transient Reactor Test Facility
ZPPR	Zero Power Physics Reactor

Metric Conversion Chart

To Convert Into Metric			*To Convert From Metric*		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092903	square meters	square meters	10.7639	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.40469	hectares	hectares	2.471	acres
square miles	2.58999	square kilometers	square kilometers	0.3861	square miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32, then multiply by 0.55556	Celsius	Celsius	Multiply by 1.8, then add 32	Fahrenheit

Metric Prefixes

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

SUMMARY

This document summarizes the U.S. Department of Energy's *Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (*TA-18 Relocation EIS*). In addition to information concerning the background, purpose and need for the proposed action, and the National Environmental Policy Act process, this summary includes the requirements for current and future Technical Area 18 missions, the alternatives and proposed relocation facilities, the Department of Energy's identified Preferred Alternative, and a comparison of environmental impacts among alternatives.

S.1 INTRODUCTION AND BACKGROUND

The National Nuclear Security Administration (NNSA), a separately organized agency within the U.S. Department of Energy (DOE), is responsible for providing the Nation with nuclear weapons, ensuring the safety and reliability of those nuclear weapons, and supporting programs that reduce global nuclear proliferation. These mission responsibilities are accomplished through the use of DOE's core team of highly trained nuclear experts. One of the major training facilities for DOE personnel is located at Technical Area 18 (TA-18) at the Los Alamos National Laboratory (LANL), Los Alamos, New Mexico. The principal TA-18 operation is the research in and the design, development, construction, and application of experiments on nuclear criticality.

TA-18 supports important defense, nuclear safety, and other national security mission responsibilities. The operations at TA-18 enable DOE personnel to gain knowledge and expertise in advanced nuclear technologies that support the following: (1) nuclear materials management and criticality safety; (2) emergency response in support of counterterrorism activities; (3) safeguards and arms control in support of domestic and international programs to control excess nuclear materials; and (4) criticality experiments in support of Stockpile Stewardship and other programs. The TA-18 facilities are the Nation's only facilities capable of performing general-purpose nuclear materials handling for a variety of experiments, measurements (to determine the presence of nuclear materials), and training. TA-18 also houses the Western Hemisphere's largest collection of machines for conducting nuclear safety evaluations and establishing limits for operations.

The primary operation at TA-18 is the performance of criticality experiments. Criticality experiments involve systems of fissile material(s), called critical assemblies, which are designed to reach a condition of nuclear criticality. The capability to conduct criticality experiments also includes development of nuclear instruments, measurement and evaluation of integral cross sections, accident simulation, dosimetry, and the detection and characterization of nuclear material. A critical assembly is a machine used to manipulate a mass of fissile material in a specific geometry and composition. The movement or addition of fissile material in the critical assembly can allow it to reach the condition of nuclear criticality and control the reactivity. A critical assembly is a small version (i.e., from several inches to several feet) of a nuclear power plant core. Fissile materials that can be used in a critical assembly typically consist of one of the following five main isotopes: uranium-233, uranium-235, neptunium-237, plutonium-239, or plutonium-241, in a specific composition and shape. A neutron source may be placed near the assembly to ensure that the fission rate of the critical assembly can be readily observed as it approaches and reaches criticality. The quantity of fissile material capable of sustaining such a reaction is called the critical mass for that assembly. Critical mass is

SPECIAL NUCLEAR MATERIALS SAFEGUARDS AND SECURITY
(DOE Order 474.17-1A)

Special nuclear materials (SNM) are defined in the Atomic Energy Act of 1954 as (1) plutonium, uranium enriched in the isotope 233 or 235, or any other material designated as SNM; or (2) any material artificially enriched by any of the above.

DOE's policy is to protect national security and the health and safety of DOE and contractor employees, the public, and the environment by protecting and controlling SNM. This is done by designing specific safeguards and security strategies to prevent or minimize both unauthorized access to SNM and unauthorized disclosure, loss, destruction, modification, theft, compromise, or misuse of SNM as a result of terrorism, sabotage, or events such as disasters and civil disorders.

DOE uses a cost-effective, graded approach to providing SNM safeguards and security. Quantities of SNM stored at each DOE site are categorized into security Categories I, II, III, and IV, with the greatest quantities included under security Category I and lesser quantities included in descending order under security Categories II through IV.

a function of many factors including the mass and enrichment of the fissile material; the geometry, or shape, of the assembly; and the presence of reflectors or neutron absorbers.

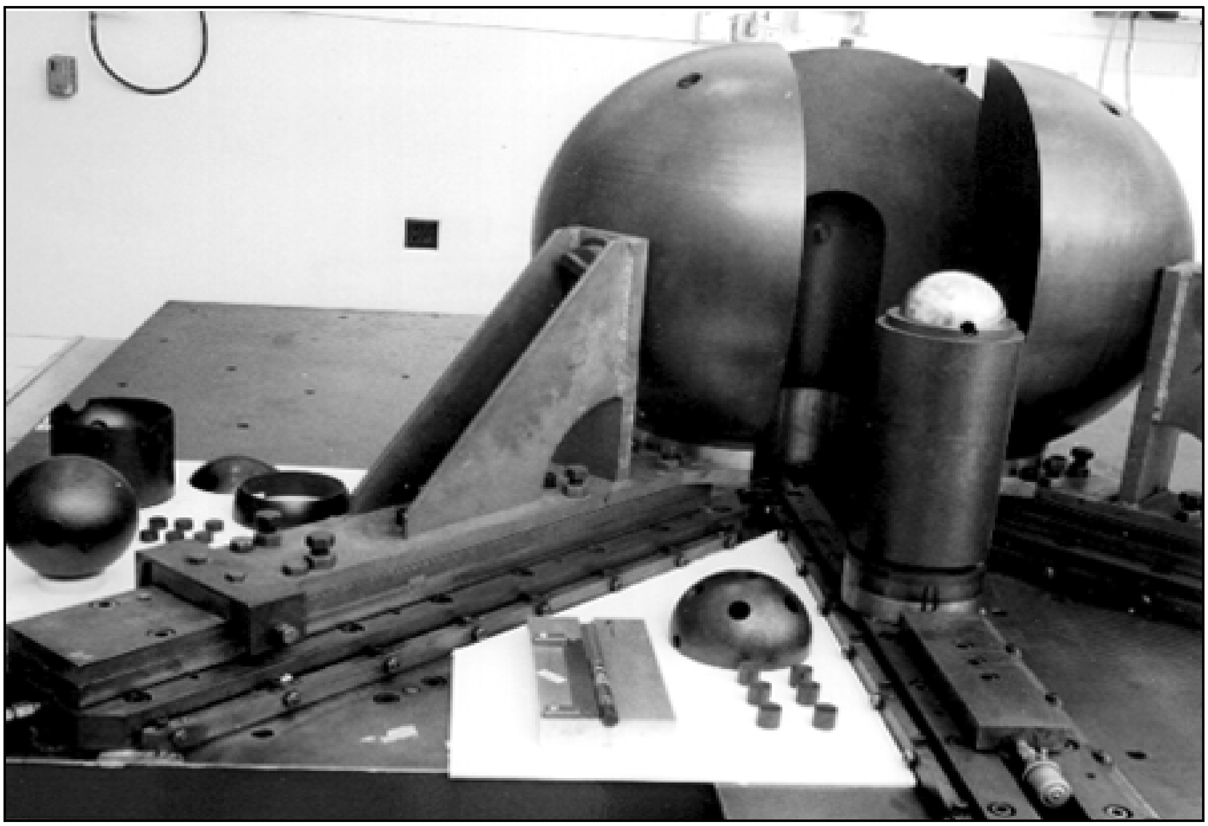
Since 1948, thousands of experiments with several fissile materials (uranium-235 and uranium-233, isotopes of plutonium, and neptunium-237) have been conducted at TA-18. These experiments have been performed with metal or compounds, both bare and reflected, as solid, liquid, and gas throughout the entire range of fast, intermediate, and thermal neutron spectra. Critical assemblies at TA-18 are designed to operate at low-to-average power and at temperatures well below the fissile material temperature operating limits (which sets them apart from normal reactors), with low fission-product production and minimal fission-product inventory. (See text box below for a discussion of a typical critical assembly.) SNM is stored in either Critical Assembly Storage Areas (CASAs) or in the Hillside vault. The onsite TA-18 nuclear material inventory is relatively stable and consists primarily of isotopes of plutonium and uranium. The bulk of the plutonium is metal and is either clad or encapsulated. The use of toxic and hazardous materials is limited.

DOE proposes to relocate the TA-18 mission operational capabilities and materials to a new location and continue to perform those mission operations at the new location for the foreseeable future (for purposes of the environmental impact statement (EIS), the operations are assessed for a 25-year operating period). As described below, the EIS evaluates four alternative locations for the proposed action as well as a TA-18 Upgrade Alternative and the No Action Alternative. The proposed action includes: transport of critical assembly machines and support equipment to a new location; modification of existing facilities to support the TA-18 missions; or construction and operation of "new" facilities for 25 years to support the TA-18 missions. Relocation of TA-18 mission operations would also include transport of up to approximately 2.4 metric tons (2.6 tons) of SNM associated with the TA-18 missions and a range of disposition options associated with the existing TA-18 facilities that would be vacated if the mission operations are relocated.

The *Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory (TA-18 Relocation EIS)* evaluates the potential direct, indirect, and cumulative environmental impacts associated with this proposed action at the following DOE sites: (1) a different site at LANL (the Preferred Alternative) at Los Alamos, New Mexico; (2) Sandia National Laboratories/New Mexico (SNL/NM) at Albuquerque, New Mexico; (3) the Nevada Test Site (NTS) near Las Vegas, Nevada; and (4) Argonne National Laboratory-West (ANL-W) near Idaho Falls, Idaho. These site alternatives were developed by a DOE-wide Option Study Group (Group) chartered to develop reasonable alternatives for the relocation of TA-18 mission operations. The Group developed criteria that screened for sites with existing security Category I infrastructure; nuclear environmental, safety, and health infrastructure; and compatibility between the site and TA-18 mission operations. The EIS also analyzes the upgrading of TA-18 facilities at LANL and the No Action Alternative.

TYPICAL CRITICAL ASSEMBLY

Critical assembly designs at TA-18 use different methods to reach a criticality condition. In some cases, additional fissile material is added in discrete quantities to an existing configuration. Other criticality assembly designs allow for a constant mass of fissile material, in two or more separate components, to be moved closer together in small increments. Some critical assembly systems incorporate movable neutron-absorbing components, which can be moved into and out of the fissile material mass to control the fission reaction. Critical assemblies can be composed of fissile materials in either solid or liquid form. For example, a critical assembly could range from a small 15-centimeter (6-inch) sphere of plutonium-239 metal with a mass of about 6 kilograms (13.2 pounds) to larger quantities of enriched uranium-235 in various shapes. An example of a critical assembly used in the TA-18 facility is the Flattop assembly, shown below. This assembly, including all of its structure, has a base of approximately 2.4 × 1.8 meters (8 × 6 feet) and a height of 1.5 meters (5 feet). The fissile material is a 15-centimeter (6-inch) sphere of enriched uranium (93 percent uranium-235) metal or plutonium-239 metal, reflected by the natural uranium hemisphere blocks.



Flattop Critical Assembly

Based on the analytical results of the EIS, as well as cost, schedule, safeguards and security issues, and other programmatic considerations which are not part of this EIS, DOE intends to make the following decisions concerning the security Category I/II, the Solution High-Energy Burst Assembly (SHEBA), and other security Category III/IV activities currently being conducted at LANL's TA-18 facilities:

- Whether to relocate the security Category I/II activities from TA-18 to a new location, or maintain these mission support operations at their current location with or without upgraded facilities. If a decision is made to relocate the security Category I/II activities, to select one of four proposed relocation sites (i.e., TA-55 at LANL, TA-V at SNL/NM, the Device Assembly Facility (DAF) at NTS, or ANL-W)

- Whether to relocate all or some of the TA-18 security Category III/IV activities to new and/or other locations at LANL (SHEBA activities to TA-39; other security Category III/IV activities to TA-55), or maintain these operations at their current location with or without upgraded facilities

The analysis in this EIS will support decision making related to eventual site-specific construction and operation activities for any alternative selected.

S.1.1 Purpose and Need for Action

Nuclear materials management is a fundamental responsibility of DOE, as its operations routinely involve the use of nuclear materials. The nuclear criticality safety, research, and training at TA-18 play a key role in ensuring that DOE handles nuclear materials in a safe manner.

The National Nuclear Security Administration is responsible for a number of activities involving the use of nuclear materials. DOE's Office of Defense Programs is responsible for maintaining the Nation's nuclear weapons program. Activities associated with this mission include handling and processing fissile materials for use in nuclear weapons and storage of special nuclear material. DOE's Emergency Response Program directly supports weapons-of-mass-destruction initiatives stemming from Executive Order 12938 and Presidential Decision Directives 39 and 62. This program is responsible for developing detection and diagnostic equipment to protect the United States against terrorist devices of unknown design and origin. Additionally, DOE's Nuclear Nonproliferation Program is responsible for developing nuclear measurement methods to verify treaty agreements with foreign nations, protect the United States against nuclear smuggling activities, and support domestic and international safeguards.

In other areas of DOE, the Environmental Management Program is responsible for cleaning up former weapons complex facilities that house surplus fissile materials in various storage arrays. The Civilian Radioactive Waste Management Program is responsible for identifying a long-term repository for high-level nuclear waste from commercial power plants. In both cases, specific information is needed on nuclear materials to determine safe storage configurations to prevent criticality events.

To carry out these missions in a safe manner, DOE needs to maintain the capability to conduct general-purpose criticality experiments and detector development with various types and configurations of special nuclear material. Additionally, DOE needs to maintain the capability to train its Federal and contractor employees to handle nuclear materials in a manner that will prevent inadvertent criticality. In 1993, and again in 1997, the Defense Nuclear Facilities Safety Board recommended that DOE continue to maintain the capability to support the TA-18 criticality experiments program.

Currently, the criticality experiments activities are conducted at a collection of facilities located at TA-18 in Los Alamos, New Mexico. TA-18 at LANL is the only DOE facility where criticality experiments routinely are performed. This collection of facilities is near the end of its useful life, and action is required by DOE to assess alternatives for continuing these activities for the next 25 years.

This EIS identifies siting options to assist DOE in determining a long-term strategy for maintaining nuclear criticality missions, infrastructure, and expertise presently residing at TA-18.

S.1.2 Scoping Process

Scoping is a process in which the public and stakeholders provide comments directly to the Federal agency on the scope of the EIS. This process is initiated by the publication of the Notice of Intent in the *Federal Register*.

On May 2, 2000, DOE published a Notice of Intent to prepare the *TA-18 Relocation EIS* (65 FR 25472). In this Notice of Intent, DOE invited public comment on the *TA-18 Relocation EIS* proposal. Subsequent to this notice, DOE held public scoping meetings in the vicinity of all sites that might be affected by the proposed action. Public scoping meetings were held as follows: (1) May 18–Albuquerque, New Mexico; (2) May 23–North Las Vegas, Nevada; (3) May 25–Idaho Falls, Idaho; and (4) May 30–Española, New Mexico (note: this public meeting was originally scheduled for May 17 at Los Alamos, New Mexico, but was rescheduled and relocated due to the Cerro Grande Fire).

All comments received, orally and in writing at these meetings, via mail, fax, the Internet, and the toll-free phone line, were reviewed for consideration by DOE in preparing the EIS.

S.1.2.1 Issues Identified During the Scoping Period

Many of the verbal and written comments received during the public scoping period identified the need for DOE to describe in detail the existing TA-18 capabilities and processes, as well as the specific requirements associated with the alternatives for fulfilling DOE's mission support needs. In particular, comments addressed the suitability of other sites to perform these mission support needs, the design of any buildings to be constructed or modified, construction and operation timelines, and controls to limit releases to the environment.

A significant number of comments also expressed concern about the costs associated with operating TA-18 criticality experiments facilities or relocating these capabilities elsewhere. These comments suggested that detailed cost analyses be conducted to analyze the construction, operation, security, and transportation needs of the various alternatives.

Many comments also addressed both the SNM needed to support, and the waste streams resulting from, TA-18 operations. Clarification was requested as to the amount of SNM that would be required under each alternative, the manner and routes of its transport, and the availability of suitable shipping containers. Waste management concerns addressed the need to identify the types and volumes of waste resulting from the proposed action; the available facilities at each site to treat, store, or dispose of the waste; the associated transportation requirements; and compatibility of the proposed action with state and Federal regulations.

Several commentors expressed concern over the environmental, health, and safety risks associated with TA-18 operations. DOE representatives were urged to thoroughly evaluate the potential consequences of the proposed action on local wildlife, water resources, and the health and safety of area residents, and to take into account the Cerro Grande Fire at LANL. Comments also suggested that the EIS quantify all radionuclide and chemical emissions resulting from the proposed action. Concerns were raised about the safety and security of the existing TA-18 facilities and how safety and security would be addressed at each of the potential relocation sites. Commentors expressed favor or opposition for a particular relocation alternative, reasons for which included security, cost, and workforce advantages.

Major issues identified through both internal DOE and public scoping are addressed in the EIS by analyses in the following areas:

- Land resources, including land use and visual resources
- Site infrastructure
- Air quality and acoustics
- Water resources, including surface water and groundwater
- Geology and soils
- Biotic resources, including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species
- Cultural and paleontological resources, including prehistoric resources, historic resources, and Native American resources
- Socioeconomics, including regional economic characteristics, demographic characteristics, housing and community services, and local transportation
- Radiological and hazardous chemical impacts during normal operations and accidents
- Waste management
- Transportation of nuclear materials

In addition to analyses in these areas, the EIS also addresses monitoring and mitigation, unavoidable impacts and irreversible and irretrievable commitment of resources, and impacts of long-term productivity.

S.1.2.2 Relationships to Other Actions and Programs

This section explains the relationship between the *TA-18 Relocation EIS* and other relevant National Environmental Policy Act (NEPA) documents and DOE programs. Completed NEPA compliance actions are addressed in Section S.1.2.2.1; ongoing actions are discussed in Section S.1.2.2.2.

S.1.2.2.1 Completed NEPA Compliance Actions

Final Environmental Assessment for Device Assembly Facility Operations (DOE/EA-0971)—The *Final Environmental Assessment for Device Assembly Operations* was issued in May 1995 and evaluates the proposed action to operate DAF at NTS. DAF is one of the facilities considered under the proposed action to receive relocated TA-18 activities.

Environmental Assessment for Consolidation of Certain Materials and Machines for Nuclear Criticality Experiments and Training – Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/EA-1104)—In May 1996, DOE issued the Environmental Assessment and Finding of No Significant Impact for *Consolidation of Certain Materials and Machines for Nuclear Criticality Experiments and Training – Los Alamos National Laboratory*. This environmental assessment compared the effects of consolidating nuclear criticality experiments machines and materials at the Los Alamos Critical Experiments Facility (LACEF) at LANL's TA-18. Actions consolidated through this environmental assessment resulted in the program which exists today and form the basis for the No Action Alternative presented in the *TA-18 Relocation EIS*.

Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement (DOE/EIS-0240)—the *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* was issued in June 1996. DOE prepared this EIS because of the need to move rapidly to neutralize the proliferation threat of surplus highly enriched uranium and to demonstrate the United States' commitment to nonproliferation. It evaluated management alternatives for materials used by TA-18 activities.

Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (DOE/EIS-0243)—The *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* was issued in August 1996. The Record of Decision was published in December 1996. The proposed action to relocate the TA-18 capabilities and materials is consistent with the decisions documented in the Record of Decision.

Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management (DOE/EIS-0236)—In September 1996, DOE issued the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*. This programmatic EIS evaluated the potential environmental impacts resulting from activities associated with nuclear weapons' research, design, development, and testing, as well as the assessment and certification of the weapons' safety and reliability. The Record of Decision was published in December 1996. Criticality experiments at TA-18 support the stockpile stewardship mission addressed in this programmatic EIS.

Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory (DOE/EIS-0238)—The *Final Site-Wide EIS for Continued Operation of LANL* (*LANL SWEIS*) was issued in January 1999. In the September 1999 Record of Decision, DOE selected the Expanded Operations Alternative. The No Action Alternative assessed in the *TA-18 Relocation EIS* is consistent with the Preferred Alternative chosen through the *LANL SWEIS* Record of Decision.

Idaho National Engineering and Environmental Laboratory Advanced Mixed Waste Treatment Project Final Environmental Impact Statement (DOE/EIS-0290)—The *Idaho National Engineering and Environmental Laboratory Advanced Mixed Waste Treatment Project Final Environmental Impact Statement* was issued in March 1999. The Record of Decision was published in the *Federal Register* on April, 1999 (64 FR 16948). The impacts of the action DOE decided to implement are factored into the assessment of potential cumulative impacts discussed in the *TA-18 Relocation EIS* proposed action.

Final Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico (DOE/EIS-0281)—The *Final Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico* (*SNL/NM SWEIS*) was issued in October 1999. The Record of Decision for the *SNL/NM SWEIS* was published in the *Federal Register* on December 15, 1999 (64 FR 69996). The proposed action to relocate the TA-18 capabilities and materials is consistent with the decision documented in the *SNL/NM SWEIS* Record of Decision.

Surplus Plutonium Disposition Final Environmental Impact Statement (DOE/EIS-0283)—The *Surplus Plutonium Disposition Final Environmental Impact Statement* was issued in November 1999. The Record of Decision for the programmatic EIS, published in the *Federal Register* on January 14, 1997 (62 FR 3014), outlined DOE's approach to plutonium disposition and established the groundwork for the *Surplus Plutonium Disposition EIS*. In the Record of Decision, published in the *Federal Register* on January 11, 2000 (65 FR 1608), DOE decided to provide for the safe and secure disposition of up to 50 metric tons of surplus plutonium as mixed oxide fuel and through immobilization. Plutonium used in support of TA-18 activities could be dispositioned, when necessary, using material management methods described in the *Surplus Plutonium Disposition EIS*.

Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel (DOE/EIS-0306)—The *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* was issued in July 2000. The Record of Decision was published in the *Federal Register* on September 19, 2000 (65 FR 56565). The proposed action under this EIS contributes to the cumulative impacts at the site discussed in the *TA-18 Relocation EIS*.

Special Environmental Analysis for the Department of Energy, National Nuclear Security Administration: Actions Taken in Response to the Cerro Grande Fire at Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/SEA-03)—In September 2000, DOE and NNSA issued this special environmental analysis to document their assessment of impacts associated with emergency activities conducted at LANL, Los Alamos County, New Mexico, in response to major disaster conditions caused by the recent Cerro Grande Fire. These emergency activities included activities taken at TA-18 that altered the TA-18 setting as discussed in the *TA-18 Relocation EIS*.

Environmental Assessment for the Microsystems and Engineering Sciences Applications Complex (DOE/EA-1335)—The *Environmental Assessment for the Microsystems and Engineering Sciences Applications Complex* was issued in September 2000 and analyzed the potential effects of constructing several new facilities and upgrading existing facilities at SNL/NM. A Finding of No Significant Impact was signed on October 16, 2000. The impacts of this action are factored into the assessment of potential cumulative impacts at SNL/NM in the *TA-18 Relocation EIS*.

Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility (Nuclear Infrastructure Programmatic EIS) (DOE/EIS-0310)—The *Final Nuclear Infrastructure Programmatic EIS* was issued in December 2000. The Record of Decision was published in the *Federal Register* on January 26, 2001 (66 FR 7877). Through the Record of Decision, DOE selected the Preferred Alternative, under which DOE will reestablish domestic production of plutonium-238, as needed, using the Advanced Test Reactor at the Idaho National Engineering and Environmental Laboratory (INEEL) in Idaho and the High Flux Isotope Reactor at Oak Ridge National Laboratory in Tennessee. The impacts of this action are factored into the assessment of potential cumulative impacts at INEEL in the *TA-18 Relocation EIS*.

Final Environmental Assessment for Atlas Relocation and Operation at the Nevada Test Site (DOE/EA-1381)—In May 2001, DOE issued the *Final Environmental Assessment for Atlas Relocation and Operation at the Nevada Test Site*. This document assesses the environmental impacts of DOE's proposed action to disassemble the Atlas pulsed-power machine at LANL and transport it to NTS, where it would be reassembled in a new building in Area 6 north of DAF. The potential effects of this action are factored into the assessment of potential cumulative impacts resulting from the *TA-18 Relocation EIS* proposed action.

S.1.2.2.2 Ongoing NEPA Compliance Actions

Draft Idaho High-Level Waste and Facilities Disposition Environmental Impact Statement (DOE/EIS-0287)—The *Draft Idaho High-Level Waste and Facilities Disposition Environmental Impact Statement* was issued in December 1999. It evaluates alternatives for managing the high-level radioactive waste and associated radioactive waste and facilities at INEEL. The proposed action under this EIS contributes to the cumulative impacts at INEEL discussed in the *TA-18 Relocation EIS*.

Sandia Underground Reactor Facility Environmental Assessment—DOE is in the process of preparing an environmental assessment for construction and operation of the Sandia Underground Reactor Facility an underground facility designed for housing the Sandia Pulsed Reactor and other possible missions at TA-V[1], should they be relocated to SNL/NM. If implemented, the construction and operation of this facility would parallel the construction and operation of the facility proposed for the TA-18 missions.

Relationships to Other LANL Projects—DOE routinely conducts planning activities at its sites to identify long-term strategies and options for maintaining infrastructure in support of various missions. As part of these efforts, potential projects or actions are identified as options for future consideration. Many of these projects never go beyond the initial planning phases due to various factors such as insufficient justification or inadequate funding.

DOE has initiated a planning effort that focuses on the long-term strategy for conducting security Category I nuclear operations at LANL. Security Category I nuclear operations at TA-18 are discussed in Section S.1. While proposals regarding TA-18 activities may fall within the scope of this plan, along with other activities such as analytical chemistry, security, and pit manufacturing, DOE has determined that the TA-18 Relocation proposal must move forward independent of this broader planning effort to ensure continuous mission support. Many of the activities in this planning effort are in the preliminary phase of consideration and the effort is too speculative at the present time for NEPA analysis. To the extent sufficient information is available, this draft EIS discusses the potential cumulative impacts from other reasonably foreseeable activities at LANL.

S.2 Project Operations and Requirements

DOE intends to continue to perform TA-18 mission operations. The mission operations, therefore, as well as the requirements to fulfill them at a new location, are those identified by current activities at TA-18 and are described below.

S.2.1 Operations

TA-18 personnel perform general-purpose nuclear materials handling, experiments, and training, including the construction and operation of high-multiplication devices, delayed critical devices, and prompt critical devices. The operational capabilities located at TA-18 enable DOE personnel to gain knowledge and expertise in advanced nuclear technologies that support the following areas:

- Nuclear Materials Management and Criticality Safety
- Emergency Response
- Nonproliferation and Safeguards and Arms Control
- Stewardship Science

Nuclear Materials Management and Criticality Safety

The objective of nuclear materials management and criticality safety activities is to ensure that fissile material is handled so that it remains subcritical under both normal and credible abnormal conditions to protect workers, the public, and the environment. This objective is relevant to all DOE programs that are responsible for safely managing SNM. The following activities would be required to support nuclear materials management and criticality safety:

- performance of experiments to support safety evaluations for nuclear material process operations

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[1] *Technical areas at SNL/NM are designated using roman numerals rather than the arabic numerals used at LANL.*

- testing and qualifying equipment and systems used to ensure nuclear criticality safety
- conducting experiments to better understand criticality impacts of nuclear materials in new physical situations
- maintaining the capability and expertise of DOE's nuclear criticality safety engineers and those who have criticality-safety-related responsibilities

Emergency Response

The Emergency Response Program elements conducted at TA-18 would include the following activities:

- training, drills, experiments, and technology development activities for emergency response personnel
- constructing mock-ups of realistic weapons designs to test, develop, and validate detection equipment and methods to maintain emergency response capabilities
- using nuclear material to conduct criticality experiments to avoid technological surprises

Nonproliferation and Safeguards and Arms Control

Operations at TA-18 have already played a pivotal role in the development of verification technology for the Strategic Arms Reduction Treaty I and Intermediate-Range Nuclear Forces Agreements. Additionally, TA-18 operational capabilities provide ongoing training of inspectors and development of safeguards technology for the International Atomic Energy Agency. The following activities would be performed to support the nuclear nonproliferation and safeguards and arms control:

- supporting development and testing of technologies for conducting nuclear measurements for verification or transparency of declarations concerning nuclear weapons
- developing and evaluating new technologies for conducting nuclear measurements to determine the presence of nuclear materials
- conducting training of law enforcement and emergency response personnel using nuclear materials in realistic settings
- providing independent assessment of other Federal agencies' technologies to assist in the selection of emergency response capabilities.

Stewardship Science

Stockpile stewardship is a principal mission responsibility of the NNSA, pursuant to national policy, presidential directives, and public law. A major element of this mission responsibility is the development and application of scientific and technical capabilities to assure the continued safety and reliability of U.S. nuclear weapons in the absence of underground nuclear testing.

S.2.2 Facilities, Personnel, and Materials Requirements

A diverse team sponsored by the DOE Office of Defense Programs was selected to review DOE's mission requirements presently supported at LANL's TA-18. This review encompassed all past, current, and any envisioned mission requirements, including all of the operational capabilities identified above. The team was tasked with recommending needed facilities, as well as requirements for special experimental equipment, personnel, and materials to support the operational capabilities and materials supported at TA-18.

Three subteams for the major mission requirements (Nuclear Materials Management and Criticality Safety, Emergency Response, and Nonproliferation and Safeguards and Arms Control) were established. The subteams were responsible for providing input for the report that delineates the facility, equipment, personnel, and material requirements to support planned and projected mission requirement workloads.

The TA-18 mission requirements review team reached consensus on the required facilities, equipment, personnel, and materials necessary to support the operational capabilities deemed necessary. The requirements are detailed in the project's *Functional and Operational Requirements Document* and are briefly discussed below.

Facilities and Equipment

The facilities needed to support current and future DOE mission requirements and TA-18 operational capabilities would consist of security Category I SNM experimental bays with control rooms for critical assembly machines, SNM storage vaults, waste storage areas, SNM shipping and receiving areas, a low-scatter facility, a radiography bay, office space, conference rooms, training facilities, access control areas, change-room facilities, a machine shop, an electronics fabrication shop, and other facilities necessary to meet the requirements for the safe handling of nuclear materials.

Four security Category I/II SNM critical assembly machines are required to support ongoing TA-18 operational capability requirements. These machines, discussed below, would be refurbished or replaced and relocated from TA-18 if a relocation alternative is selected.

- A general-purpose vertical-lift table machine for training and initial assembly of new experiments. Vertical-lift machines are ideal for this purpose because the stored energy for disassembly is provided by gravity. At the present time, the Planet machine provides this function.

- A fast-neutron-spectrum benchmarked assembly for validation of calculational methods, basic measurements of nuclear data of interest to defense and nuclear nonproliferation programs, and training. At the present time, the Flattop assembly serves this purpose.

- A pulse assembly to validate dynamic weapons models, verify the function of criticality alarm systems to a fast transient, calibrate detectors, and validate radiation dosimetry. The Godiva assembly provides this function at the present time. The Godiva assembly is particularly appropriate for the validation of dosimetry.

- A large-capacity, general-purpose vertical table machine to accommodate benchmark experiments designed to explore unknowns. The Comet machine at TA-18 is currently used for this purpose. It is presently stacked with a massive assembly to evaluate intermediate neutron spectra for the first time.

The current operations at TA-18 are also supported by SHEBA, a low-enriched uranium-solution critical assembly security Category IV SNM machine. It provides capabilities for free-field irradiation of criticality alarm systems and dosimetry validation. The SHEBA activities relocation under the various alternatives is discussed in detail in the EIS.

Personnel

Technical staff are needed (including physicists, engineers, and technicians) to perform existing TA-18 and new-facility mission support functions. These personnel require significant unique experience in nuclear criticality safety experiments and nuclear materials handling; neutron, gamma, and x-ray measurements; nuclear instrumentation design; and real-time radiography. Additionally, the personnel need significant experience in hazard Category 2, security Category I/II SNM nuclear facility operations, authorization-basis development and maintenance, and quality assurance. Also, a number of other support personnel, including safeguards-and-security-knowledgeable personnel, are needed to implement the security requirements for the protection of SNM.

Materials

The current inventory of nuclear material at TA-18 consists of approximately 2.8 metric tons (3.1 tons) of security Category I SNM and 18.5 metric tons (20 tons) of depleted and natural uranium and thorium. However, as a result of a concerted effort to reduce unnecessary site inventory, the forecasted mission support need would be to accommodate approximately 2.4 metric tons (2.6 tons) of security Category I SNM and 10 metric tons (11 tons) of depleted natural uranium and thorium (which do not require special security arrangements). The SNM inventory would consist of uranium in various forms and enrichments and plutonium (mostly metals, double-encapsulated or clad), with a wide variety of contents including plutonium-240, uranium-233, neptunium-237, thorium, and other isotopic sources.

S.3 Development of Reasonable Alternatives

The *TA-18 Relocation EIS* evaluates the environmental impacts associated with the proposed action of relocating TA-18 capabilities and materials associated with security Category I/II activities to a new location. Location alternatives include the following DOE sites: (1) a different site at LANL at Los Alamos, New Mexico; (2) SNL/NM at Albuquerque, New Mexico; (3) NTS near Las Vegas, Nevada; and (4) ANL-W near Idaho Falls, Idaho. These site alternatives were developed by a Department-wide Option Study Group chartered to develop reasonable alternatives for the relocation of TA-18 operations. Criteria were developed that screened for sites with existing security Category I/II infrastructure; nuclear environmental, safety, and health infrastructure; and compatibility between the site and TA-18 operational capabilities. In conjunction with the relocation of security Category I/II activities the EIS also evaluates the environmental impacts associated with the relocation of TA-18 security Category III/IV activities within LANL. The alternatives evaluated in the EIS are as follows:

<u>TA-18 Upgrade Alternative</u>—This alternative would involve upgrading the buildings, infrastructure and security infrastructure of the existing TA-18 facilities to continue housing these TA-18 operations at their present location at LANL. Under this alternative, some construction activities would be necessary.

<u>LANL New Facility Alternative</u>—This alternative would involve housing the security Category I/II activities in a new building to be constructed near the Plutonium Facility 4 at TA-55. Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at TA-39 or remain at TA-18; the rest of the security Category III/IV activities would either be relocated to a new structure at TA-55 or remain at TA-18.

<u>SNL/NM Alternative</u>—This alternative would involve the housing of the security Category I/II TA-18 operations within a new security Category I/II facility within TA-V at SNL/NM. Currently, SNL/NM operates a variety of research-oriented nuclear facilities at TA-V. A new underground facility and modifications to existing buildings would be required. Under this alternative, a portion of the security

Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at LANL's TA-39 or remain at TA-18; the rest of the security Category III/IV activities would remain at TA-18.

NTS Alternative—This alternative would involve the housing of the security Category I/II TA-18 operations in and around the existing DAF. Currently, DAF is used for the assembly of subcritical assemblies, as well as other miscellaneous national security missions. Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at LANL's TA-39 or remain at TA-18; the rest of the security Category III/IV activities would remain at TA-18.

ANL-W Alternative—This alternative would involve the housing of the security Category I/II TA-18 operations in the existing Fuel Manufacturing Facility (FMF) and other existing buildings at ANL-W. New construction to expand the existing FMF would be required to accommodate the TA-18 operations. Security upgrades would also be necessary. Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at LANL's TA-39 or remain at TA-18; the rest of the security Category III/IV activities would remain at TA-18.

No Action Alternative—As required by Council on Environmental Quality regulations, the *TA-18 Relocation EIS* includes the No Action Alternative of maintaining the TA-18 operations at the current location. This alternative would maintain the current missions at TA-18 as described in the Expanded Operations Alternative of the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory (LANL SWEIS)* and the associated Record of Decision (64 FR 50797). No upgrades or alternatives of either building, infrastructure or security infrastructure would occur.

Table S–1 illustrates the proposed relocation sites for the TA-18 capabilities and materials.

Table S–1 Proposed Relocation Sites for TA-18 Capabilities and Materials

Activities	*No Action Alternative*	*TA-18 Upgrade Alternative*	*LANL New Facility Alternative*	*SNL/NM Alternative*	*NTS Alternative*	*ANL-W Alternative*
Security Category I/II	TA-18	TA-18	TA-55	TA-V	DAF	FMF/ZPPR
SHEBA (Security Category IV)	TA-18	TA-18	TA-39 or TA-18	TA-39 or TA-18	TA-39 or TA-18	TA-39 or TA-18
Other Security Category III/IV	TA-18	TA-18	TA-55 or TA-18	TA-18	TA-18	TA-18

ZPPR = Zero Power Physics Reactor.

S.3.1 Planning Assumptions and Basis for Analysis

For the *TA-18 Relocation EIS* alternatives, the EIS evaluates relocating the operations currently performed at LANL's TA-18 to one of four alternative locations. The EIS evaluates the direct, indirect, and cumulative impacts associated with (1) the relocation of criticality operational capabilities and support equipment to each of the four alternative locations; (2) the relocation of some of the inventory of nuclear materials currently stored at TA-18 to each of the four alternative locations; (3) the construction of new or the modification of existing facilities to accommodate the security Category I/II activities at each of the alternative locations; and (4) the operation of the new or existing facility(s) for a 25-year duration. The EIS also discusses in a generic and qualitative manner the eventual decontamination and decommissioning of any new facility proposed for construction and the disposition of TA-18 buildings, infrastructure, and surplus equipment after the proposed relocation. In addition, the EIS evaluates the environmental impacts associated with the continuation of the operations at TA-18 by upgrading the existing TA-18 facilities (TA-18 Upgrade Alternative) and the relocation of SHEBA and other security Category III/IV activities, currently performed at TA-18, to another location(s) within LANL. Some of the more specific assumptions and considerations that form the bases of the analyses and impact assessments that are the subject of the EIS are presented below.

- As required by the Council on Environmental Quality regulations, the *TA-18 Relocation EIS* evaluates a No Action Alternative for comparison purposes. The No Action Alternative, which currently supports mission requirements at TA-18, may limit DOE's ability to support future DOE mission requirements unless significant upgrades to TA-18 infrastructure are accomplished.

- TA-18 operations consist of security Category I/II activities, as well as security Category III/IV activities. Security concerns regarding the relocation of TA-18 mission operations primarily involve security Category I/II activities. Relocating the TA-18 security Category I/II activities to a new location within an existing security Category I/II area has the potential to reduce life-cycle costs and improve safeguards and security. While there are no similar security concerns involving security Category III/IV activities, existing infrastructure problems at TA-18 necessitate addressing the relocation of these activities in conjunction with the relocation of security Category I/II activities. The separate treatment of the relocation of TA-18 activities in terms of security categories is reflected in the presentation of the alternatives as discussed in Section S.3.2.

- The projected start dates and estimated duration of modifications and construction for each alternative vary with each site. The periods fall in the range of 2 to 3 years. For the purpose of the analysis, it was assumed that construction under any of the alternatives would start sometime in 2004 to 2005 and would be completed by sometime in 2007 to 2008, for a construction period of 3 years. Operations would start in 2008. In accordance with the *Functional and Operational Requirements Document*, the TA-18 replacement facility subsystems and components (including criticality experiments machines) would be designed for a service life of at least 25 years. Therefore, the EIS assesses the environmental impacts associated with the operation of the existing or new facilities for a period of 25 years, at which time the structures would undergo decontamination and decommissioning.

- The new buildings proposed for the relocation of the TA-18 capabilities and materials are in a preliminary design stage. Therefore, they are not described in detail in the EIS. However, for the purpose of the environmental impact analysis, conservative assumptions have been used such that construction requirements and operational characteristics of these buildings would maximize the environmental impacts. Thus, the potential impacts from the implementation of the finalized-design alternatives would be less severe than those analyzed in this EIS.

- Of the critical assembly machines proposed for relocation, Comet, Planet, and Flattop are over 40 years old, and extensive refurbishment or replacement of these machines would be required before continuing their missions. Godiva is slightly more modern, and many of its subsystems have been recently upgraded.

  Flattop would be rebuilt using the original uranium parts; all other parts would be new. A new smaller table would be built with separated hydraulics and electrical components, simplified and more accessible control rod drives, and a modern control system. The refurbishment is expected to have minimal environmental impacts, and its operational characteristics would remain the same. The old table, electrical racks, and hydraulic systems would be disposed of as low-level radioactive waste. The waste stream would be less than 4.6 metric tons (5 tons) of low-level radioactive waste. There is a potential that lead-based paint may have been used on the table, which would result in part of the waste stream being characterized as mixed radioactive waste.

The two general assembly machines (Comet and Planet) would be moved, one at a time, to the new facility in a staged transition. This would require building a new machine stand and control assembly. A second control cartridge and stand would be manufactured, and the second machine would then be moved and brought into service. The waste stream would include two control cartridges and two machine stands and would be less than 0.9 metric tons (1 ton) of low-level radioactive waste each. The machine stands may potentially have lead-based paint on them due to the formulation of most paints at the time the stands were painted.

The Godiva stand would be used as is. It would be defueled before shipment and reassembled at the final destination. Most of the hydraulic and air systems have been refurbished recently. The 110-volt alternating-current control system would be replaced by a 24-volt direct-current control system. Some of the limit switches and wiring would be refurbished. The waste stream would be minimal and would be mostly low-level radioactive waste.

- Unique technical knowledge and experience in nuclear criticality is necessary to maintain TA-18 operational capabilities and to fulfill programmatic requirements. The expertise required to perform each mission set overlaps certain key skills such that many of the technical experts work in two or more major programmatic areas and, therefore, cannot easily be separated. Additionally, TA-18 technical personnel interact routinely with multiple organizations in LANL to collaborate on research and development issues involving weapon design and detector technology.

  To capitalize on this synergy, DOE has determined that LANL will retain responsibility for the TA-18 missions, regardless of the final location for security Category I/II operations. If a location other than LANL were selected for security Category I/II operations, LANL personnel will continue to maintain responsibility for those missions. Under this scenario, it is likely that security Category I/II operations would be conducted in a campaign mode with LANL personnel traveling to the new location on a temporary basis to conduct experiments. In addition, up to 20 support and operations personnel may be permanently relocated. To minimize programmatic impacts to TA-18 missions, DOE proposes that security Category III/IV operations remain at LANL so that TA-18 personnel can continue to routinely collaborate with other experts in a research and development environment.

- Proven technology is used as a baseline. No credit is taken for emerging technology improvements.

- The core set of accident scenarios selected from the LANL *Basis for Interim Operations for the Los Alamos Critical Experiments Facility (LACEF) and Hillside Vault (PL-26)* are applicable to each relocation alternative with adjustments to certain parameter values (e.g., leak path factors and materials at risk) to reflect site-specific features. Added to the core set of accidents are other site-specific accidents, if any, caused by natural phenomena or accidents at collocated facilities, that have the potential for initiating accidents at the relocated TA-18 facilities. The impacts of accidents analyzed for each alternative reflect and bound the impacts of all reasonably foreseeable accidents that could occur if the alternative were implemented.

- Decontamination and decommissioning of facilities as a result of the proposed action pertains to two distinct areas: (1) decontamination and decommissioning of the existing TA-18 facilities if all current operations and materials are relocated and no other program support personnel use the vacated facilities, and (2) decontamination and decommissioning of existing or new relocation facilities at the end of the 25-year proposed operation period. At the present time, the ultimate disposition of either the existing TA-18 structures or the proposed equipment for relocation and its associated new structures is not known. However, the current condition and contamination history of the TA-18 facilities and the projected use of the alternative facilities allows a qualitative assessment of the nature and extent of decontamination that would be required to allow the facilities to be released for unrestricted use.

- The relocation of the operational capabilities associated with security Category I/II activities from TA-18 would require transportation of the critical assembly machines as well as the security Category I SNM currently stored at TA-18 to the relocation site. This includes the transportation of up to approximately 2.4 metric tons (2.6 tons) of SNM to the relocation sites. Any nuclear material currently at TA-18 not deemed needed for future missions would be dispositioned through normal channels by DOE and LANL in accordance with previously prepared or future NEPA documents.

- The current operational characteristics of the critical assembly machines form the basis for the impact analysis at all other locations. These characteristics, based on the current operation of TA-18 facilities as described in the *LANL SWEIS*, are presented in **Table S–2** and discussed briefly below.

Table S–2 Operational Characteristics at TA-18

Electricity usage	2,836 megawatt-hours per year
Water usage	14.6 million liters per year
Nonradiological gaseous effluent	None
Radiological gaseous effluent	10 curies per year, argon-41 (Godiva); 100 curies per year, argon-41 (SHEBA)
Nonradiological liquid effluent	None
Radiological liquid effluent	None
Chemical effluent	None
Workforce	212 workers
Worker dose	21 person-rem per year, based on 212 workers
Waste generation	
- High-level radioactive waste	None
- Transuranic waste	None
- Low-level radioactive waste	145 cubic meters per year
- Mixed low-level radioactive waste	Less than 2 cubic meters per year
- Chemical waste (RCRA/TSCA waste)	4,000 kilograms per year
- Sanitary waste	14.6 million liters per year

RCRA = Resource Conservation and Recovery Act; TSCA = Toxic Substances Control Act.

Infrastructure Parameters—Activities associated with the operations at TA-18 are not energy- or water-use intensive. Electricity and water use at TA-18 are a small fraction of the site-wide use and would continue to be small fractions in all proposed relocation sites. There is limited use of natural gas and propane at TA-18.

Nonradiological Effluent—Criticality experiments and supporting activities do not involve nonradiological effluent in either gaseous or liquid form. However, diesel generators may be used as a source of emergency power at new locations. Emissions from diesel generator operation are included in the environmental analysis.

Radiological Effluent—The critical assemblies are designed to operate at low power and at temperatures well below phase-change transition temperatures. They do not generate significant radiological inventory of long-lived fission products and do not require forced convection cooling. Therefore, air-activation products, produced by interactions with the air outside of critical assemblies, are the primary source of air emissions.

Among the critical assemblies in TA-18, those intended for prompt critical operation, namely the Godiva assembly and SHEBA, are the major source of air-activation products. The Godiva assembly, in the past, was frequently operated outside of the remote-controlled CASA that houses it. This practice would not be continued if the activities are relocated. SHEBA, which is housed in a small weather-proof building that provides no shielding, is the major contributor to the air-activation products. The Planet, Comet, and Flattop assemblies run at lower-power levels (low fission rates) and operate inside the building, which reduces the air-activation products.

The air-activation products are generated from neutron interaction with air molecules containing argon, nitrogen, and oxygen. The radionuclide of greatest concern is argon-41, due to its 1.82-hour half-life and relatively large neutron-absorption cross section.

Air-activation products from neutron interaction generated during the operation of SHEBA and the Godiva assembly (assumed to be operating outside of CASA 3) were estimated assuming a 120-meter (394-foot) hemisphere of air surrounding each critical assembly. Although future operations of Godiva would not take place outside, if relocated, argon-41 generation from the Godiva assembly operations is conservatively assumed to be 10 curies per year. Argon-41 generation from SHEBA operations is assumed to be 100 curies per year. There is no argon-41 generation from the operation of the other critical assemblies.

Chemical Effluent—Criticality experiments and supporting activities do not involve the normal release of any chemicals in a gaseous or liquid form.

Worker Dose—The total annual dose to workers at TA-18 was estimated to be 21 person-rem for 212 workers. This corresponds to an average of 0.1 rem per worker per year, which was assumed to be the single worker annual dose from routine operations.

Workforce—The workforce at TA-18 is approximately 200. For the purpose of estimating total worker dose, the workforce at sites other than TA-18 was assumed to be 100 (excludes personnel for security Category III/IV activities). For the purpose of assessing socioeconomic effects, it was assumed that up to 20 persons would relocate permanently away from LANL, should a site other than LANL be selected.

Waste Generation—Criticality experiments and supporting activities involve some generation of low-level radioactive waste, primarily consisting of personnel protective equipment, wipes and rags. They also involve the generation of small quantities of mixed low-level radioactive waste consisting of machine shop scraps, solvents, and wipes. No high-level radioactive or transuranic waste is generated. The operations involve the generation of about 4,000 kilograms (8,800 pounds) of hazardous chemical solids annually from chemicals and solvents used during support activities. Also, nonhazardous wastes are generated (such as office paper and other debris).

S.3.2 Alternatives Evaluated

S.3.2.1 No Action Alternative

As required by Council on Environmental Quality regulations, the *TA-18 Relocation EIS* evaluates the No Action Alternative of maintaining the operations and materials at the current TA-18 location. Under the No Action Alternative, current operational capabilities and materials at TA-18 would be maintained as described in the Expanded Operations Alternative of the *LANL SWEIS* and associated Record of Decision (64 FR 50797). The No Action Alternative may limit DOE's ability to support future DOE mission support requirements unless significant upgrades to the TA-18 infrastructure are accomplished.

Facilities

Under the No Action Alternative, the operations conducted at TA-18 would continue at the level described in the *LANL SWEIS* with no major buildings, facility modifications, or changes to the infrastructure associated with buildings or safeguards and security. Current SNM inventories (all security categories), as well as the criticality experiments machines, would remain in place.

The TA-18 buildings and structures are located at the Pajarito site, about 5 kilometers (3.1 miles) from the nearest residential area (the White Rock community) and about 400 meters (0.25 miles) from the closest technical area (TA-54) (see **Figure S–1**). The Pajarito site is in an arid canyon and the surrounding canyon walls provide some natural shielding for the TA-18 facilities.

The facilities consist of three remote-controlled laboratories (Buildings 23, 32, and 116), or CASAs, and a separate weatherproof shelter near Building 23 that houses the SHEBA machine (Building 168). These facilities are located some distance from the main laboratory (Building 30) that houses individual control rooms for these remote-controlled laboratories. A Perimeter Intrusion Detection and Assessment System (PIDAS) security fence surrounds each CASA. The SHEBA building is within the PIDAS of CASA 1.

Each CASA is surrounded by a physical security boundary that is evacuated before remote operation, and automatic signals forewarn anyone who might be overlooked during building evacuation prior to the initiation of experimental operations. When the gate to this area is open, operation is prevented by interlocks and by key-actuated switches that require the same (captive) key for applying power to assemblies and for opening the site.

S.3.2.2 TA-18 Upgrade Alternative

Under this alternative, the building infrastructure and security infrastructure at TA-18 would be upgraded to maintain the operations and SNM activities (all security categories) at the existing TA-18 facilities.

Facilities

For the TA-18 facilities to meet expected operational requirements and security needs, significant upgrades at TA-18 would be required. New construction and modifications proposed for continuing operations at TA-18 are described briefly below.

New construction would consist of: (1) a new one-story office and laboratory building, (2) a new one-story control room, (3) a new one-story pre-engineered metal storage building (dome warehouse), and (4) a storage vault added to Building 26 (Hillside vault). **Figure S–2** provides a plan view of proposed modifications to existing structures and the addition of new structures. The figure provides three options for the location of the new office and laboratory space, shows the location of the new vault, provides two options for the location of the dome warehouse, and provides two options for the location of the control-room addition. The EIS evaluates Option 3 for the laboratory and office addition, Option 2 for the dome warehouse, and Option 2 for the control-room addition. These options were selected to maximize the impacts from a land-use point of view. In addition to new construction, various modifications to existing facilities would be needed, such as reroofing, reinforcing walls, painting, sealing cracks, and replacing glass blocks**.** **Figure S–3** provides details of the proposed new construction.

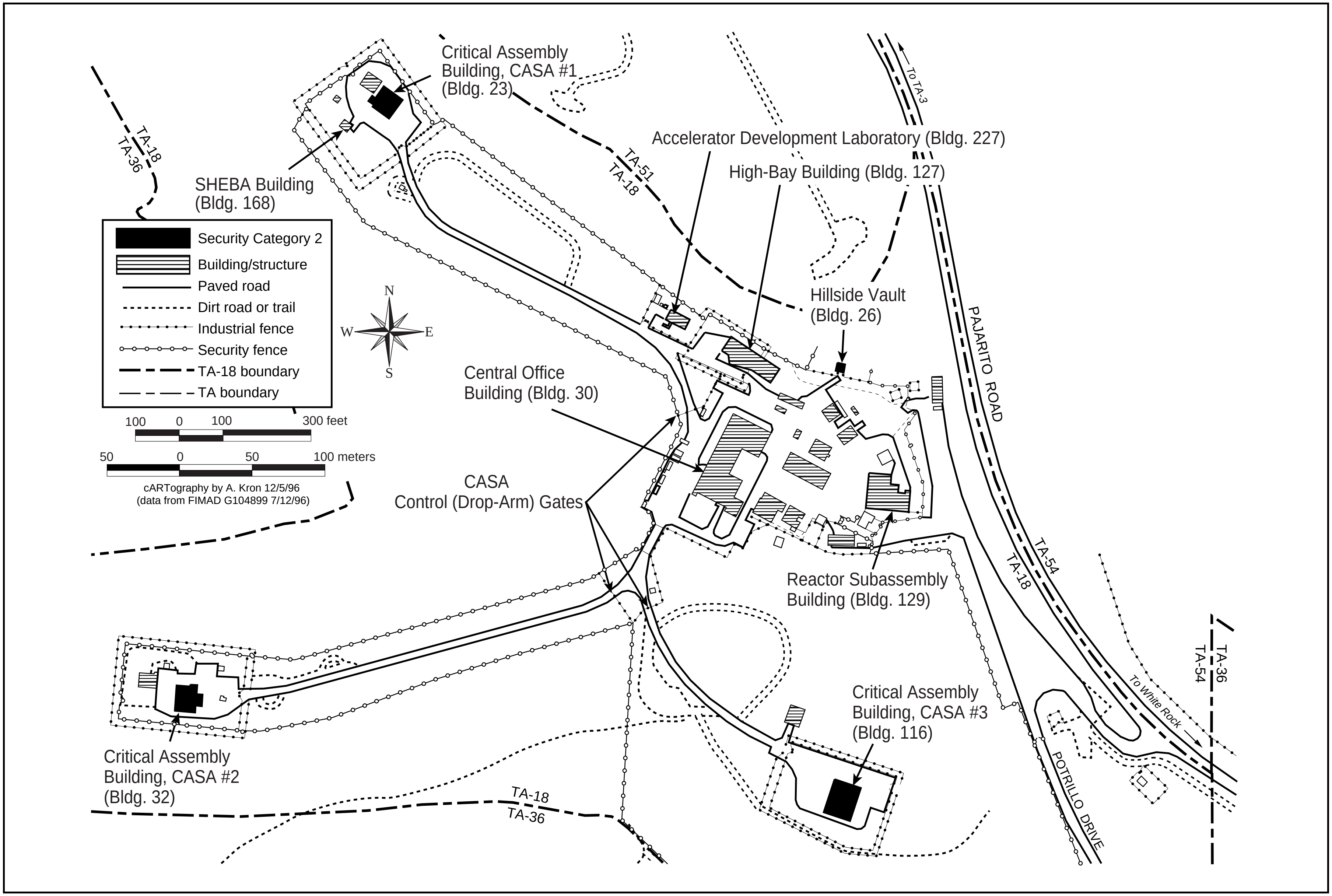

Figure S–1 TA-18 Pajarito Site

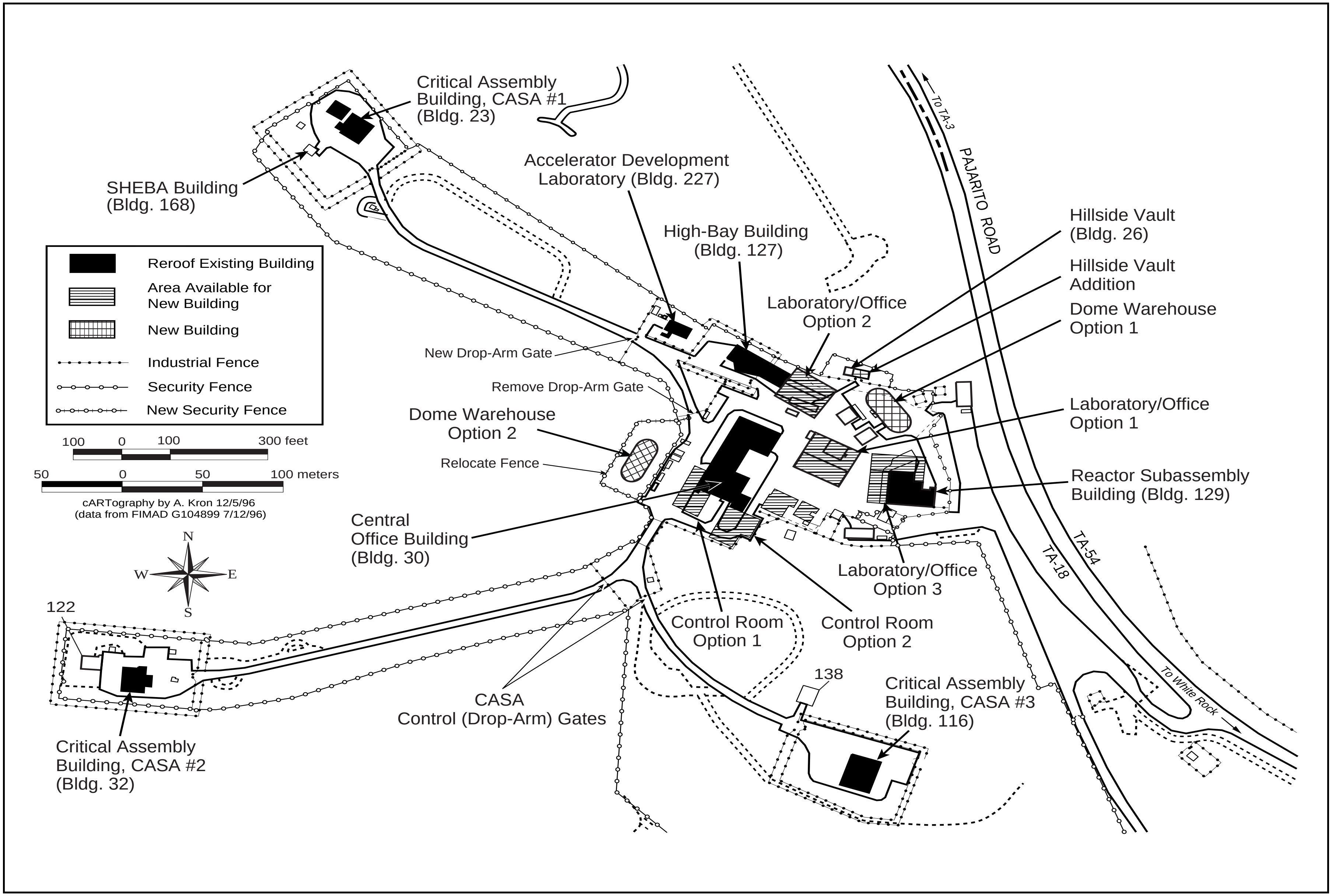

Figure S–2 TA-18 Proposed Modifications Plan (TA-18 Upgrade Alternative)

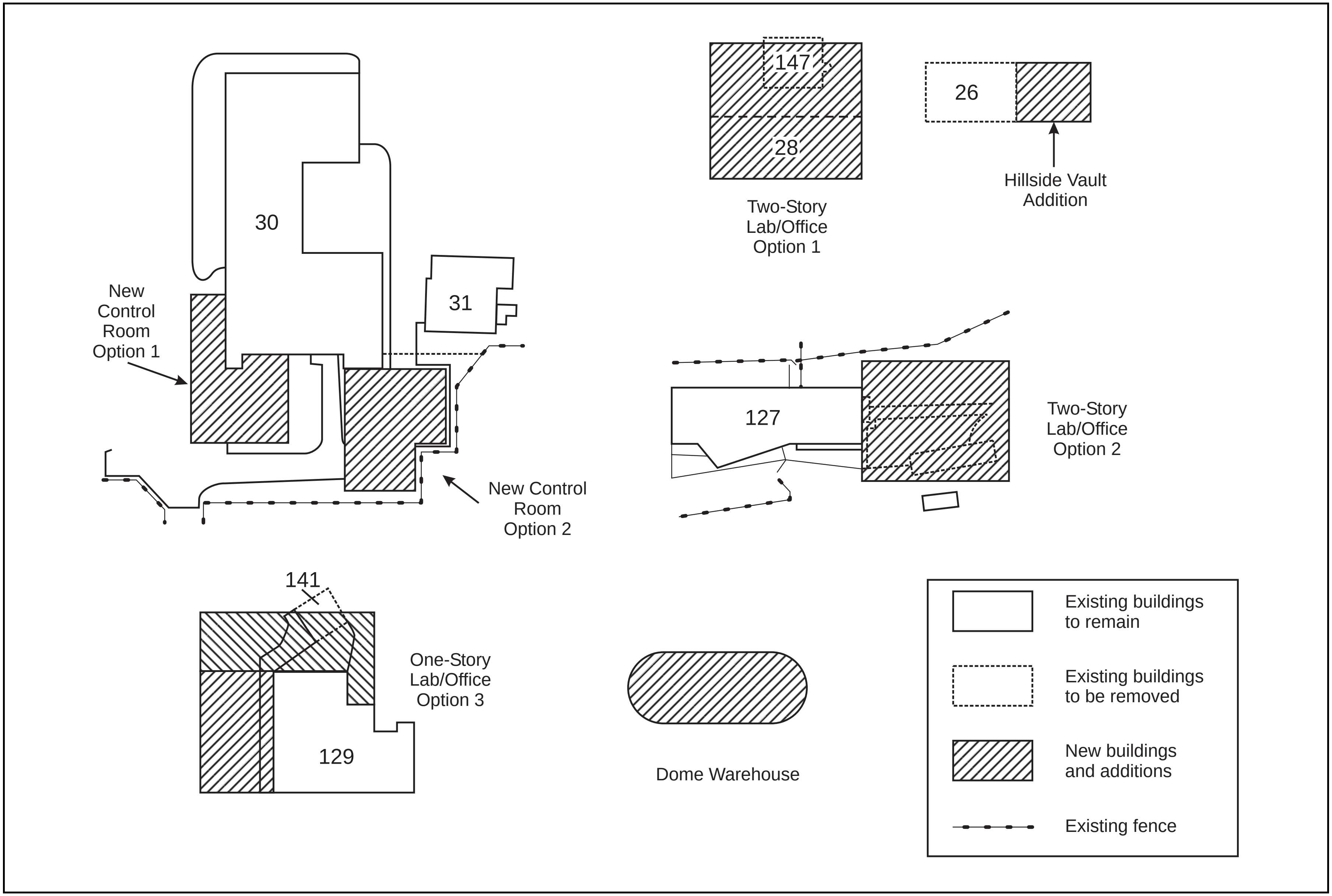

Figure S–3 TA-18 Proposed New Construction (TA-18 Upgrade Alternative)

In addition to new construction, the following would be needed:

- Installation of high-efficiency particulate air filters in conjunction with negative pressurization of the CASAs
- Extensive paving and surfacing improvements
- Replacement of potable and fire-protection water systems
- Replacement of the sanitary sewage system
- Storm-water management improvements
- Site grading
- Additions or replacements of heating, ventilating, and air conditioning; power distribution and monitoring; lightning protection; grounding; and surge suppression
- PIDAS upgrades
- Physical security enhancements

S.3.2.3 LANL New Facility Alternative

This alternative would involve the relocation of TA-18 operational capabilities and materials associated with security Category I/II activities to new buildings northwest of the existing Plutonium Facility 4 in LANL's TA-55 and extension of the existing TA-55 PIDAS. The location of the proposed new buildings is shown in **Figure S–4**. The site plan for the proposed buildings is shown in **Figure S–5**. Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at TA-39 or remain at TA-18. The rest of the security Category III/IV activities would either be relocated to a new structure at TA-55 or remain at TA-18. The relocation of SHEBA and other security Category III/IV activities to new structures at LANL is discussed in Section S.3.2.7.

Facilities

The new security Category I/II operations buildings would consist of above-grade structures that would house support operations and below-grade structures that would house critical assembly areas and SNM vaults. The critical assembly level would consist of criticality bays and SNM vaults that would be below-grade, with a minimum of 6 meters (20 feet) of cover consisting of rubble and earth. This level would consist of approximately 3,252 square meters (35,000 square feet) of floor space. Construction of the below-grade portions of the facility would consist of reinforced concrete. **Figure S–6** shows the location of the critical assembly machines and SNM vaults at the critical assembly level.

The control-room level would consist of the control rooms for the criticality bays and other support areas. The control-room level would be at grade and constructed of reinforced concrete. This level would consist of approximately 1,161 square meters (12,500 square feet) of floor space.

The new low-scatter bay would be a pre-engineered-type building with a 5-meter-deep (15-foot-deep) basement. The building would consist of approximately 604 square meters (6,500 square feet) of floor space.

S.3.2.4 SNL/NM Alternative

This alternative would involve the housing of the TA-18 operational capabilities and materials associated with security Category I/II activities within TA-V at SNL/NM. Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at LANL's TA-39 or remain at TA-18. The rest of the security Category III/IV activities would remain at TA-18 (see Section S.3.2.7).

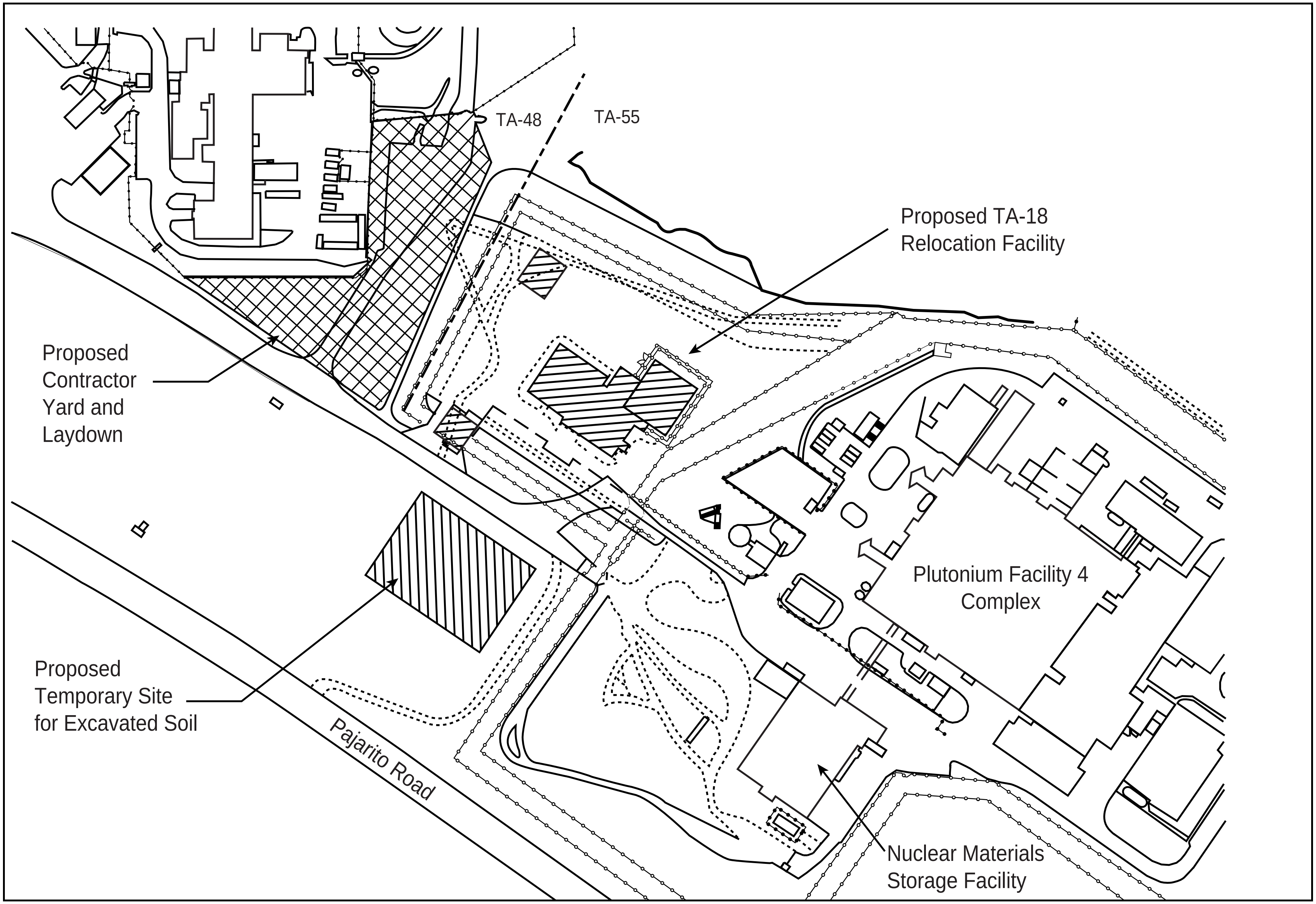

Figure S–4 Location of the Proposed New Facility (LANL New Facility Alternative)

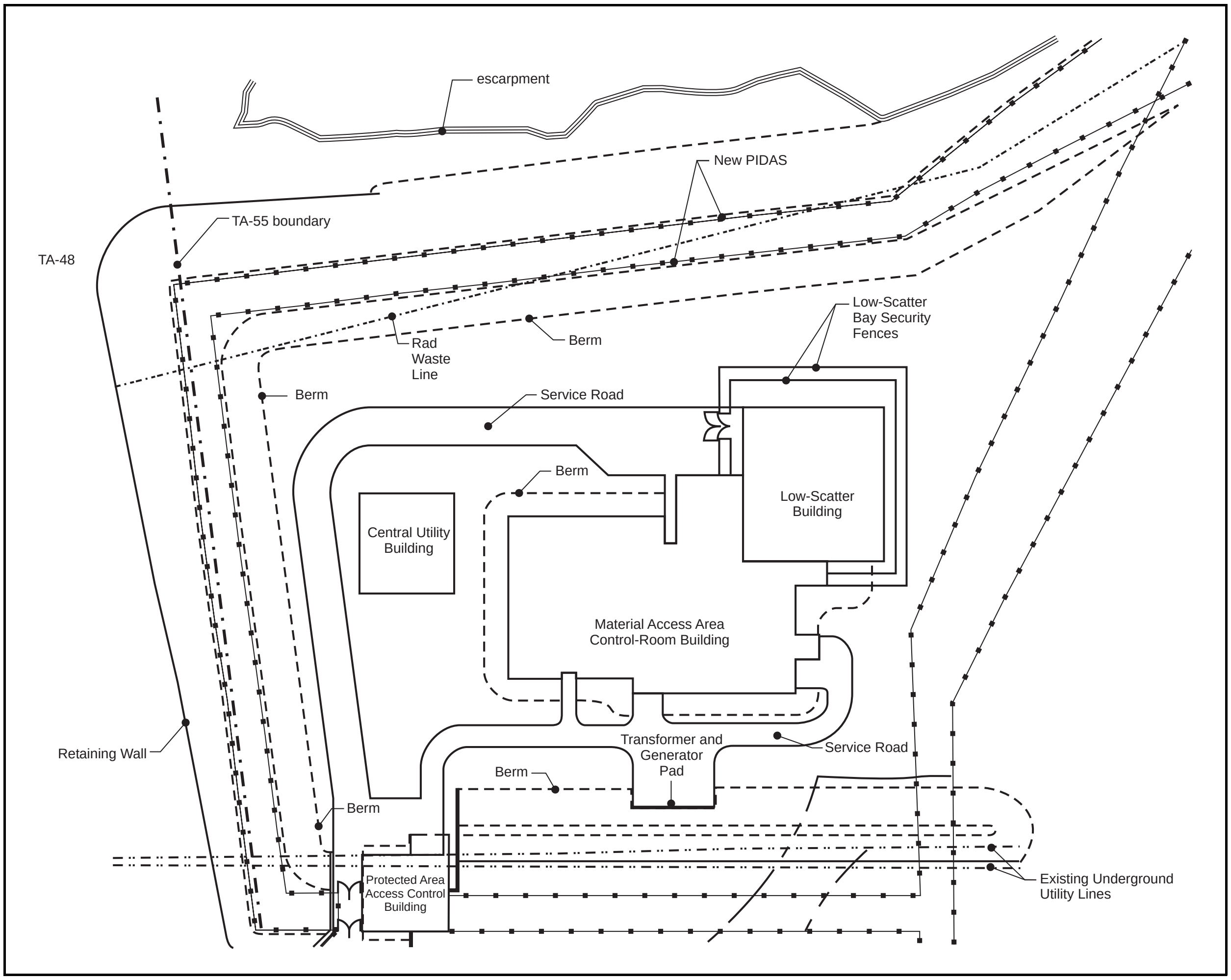

Figure S–5 Site Plan for Proposed LANL Facility (LANL New Facility Alternative)

Facilities

To support the relocation of TA-18 operational capabilities and materials associated with security Category I/II activities, it is proposed to construct a new underground facility and modify or renovate 10 existing aboveground buildings. All construction and renovation activities would be within SNL/NM's TA-V. The locations of the proposed new facility and existing buildings are shown in **Figure S–7**.

The overall size of the new underground facility would be approximately 3,286 square meters (35,370 square feet); the areas proposed to be renovated in all 10 existing buildings would total approximately 5,007 square meters (53,895 square feet). Proposed new underground construction would include nuclear material storage vaults, the larger portion of the critical assembly facility, the active interrogation facility, and a general-purpose nuclear material work bay. **Figure S–8** shows a schematic of the underground facility.

Structures that would be located in the aboveground renovations would include emergency response staging and maintenance, electronics, and a machine shop and instrumentation laboratory in the Hot Cell Facility (Building 6580); the critical assembly control rooms and warehouse in the Auxiliary Hot Cell (Building 6597); a low-scatter facility in the chapel (Building 6596); waste management storage areas in the warehouse (Building 6595); and explosive storage and radioactive-source storage areas in the Reactor Maintenance Facility (Building 6593). An existing shop (Building 6591) would also be used as a staff shop.

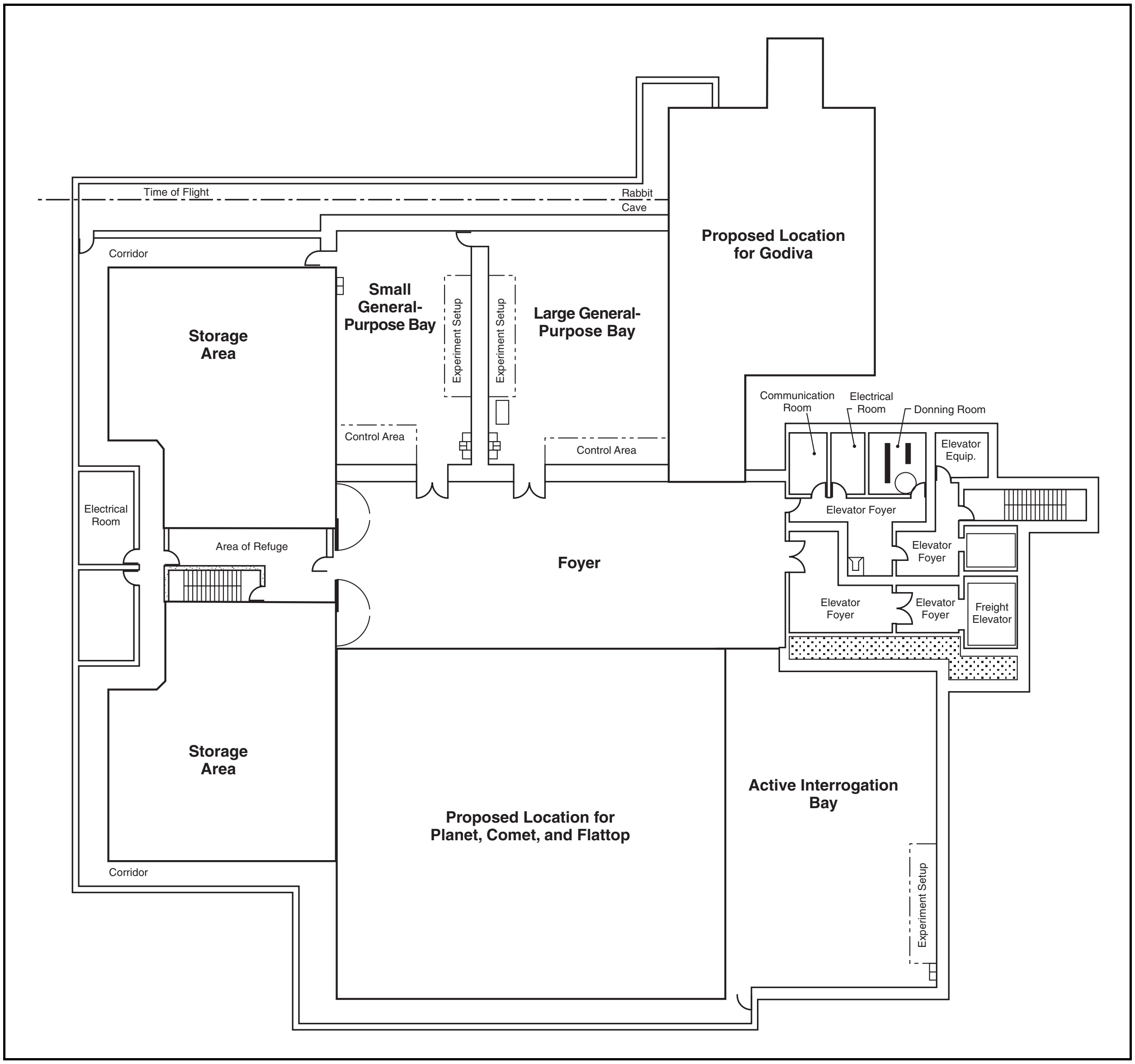

Figure S–6 Location of Critical Assembly Machines and SNM Vaults

S.3.2.5 NTS Alternative

This alternative would involve housing the TA-18 operational capabilities and materials associated with security Category I/II missions in and around the existing DAF at NTS. For this purpose, DAF would be modified internally to accommodate the critical assembly machines, control rooms, and SNM vaults, and two new buildings would be constructed external to the DAF security perimeter. The two new buildings would be a "low-scatter" facility to house emergency response activities with minimal reflection and a new administration building to accommodate a DAF Central Command Station and increased staffing associated with the TA-18 security Category I/II operations. Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at LANL's TA-39 or remain at TA-18. The rest of the security Category III/IV activities would remain at TA-18 (see Section S.3.2.7).

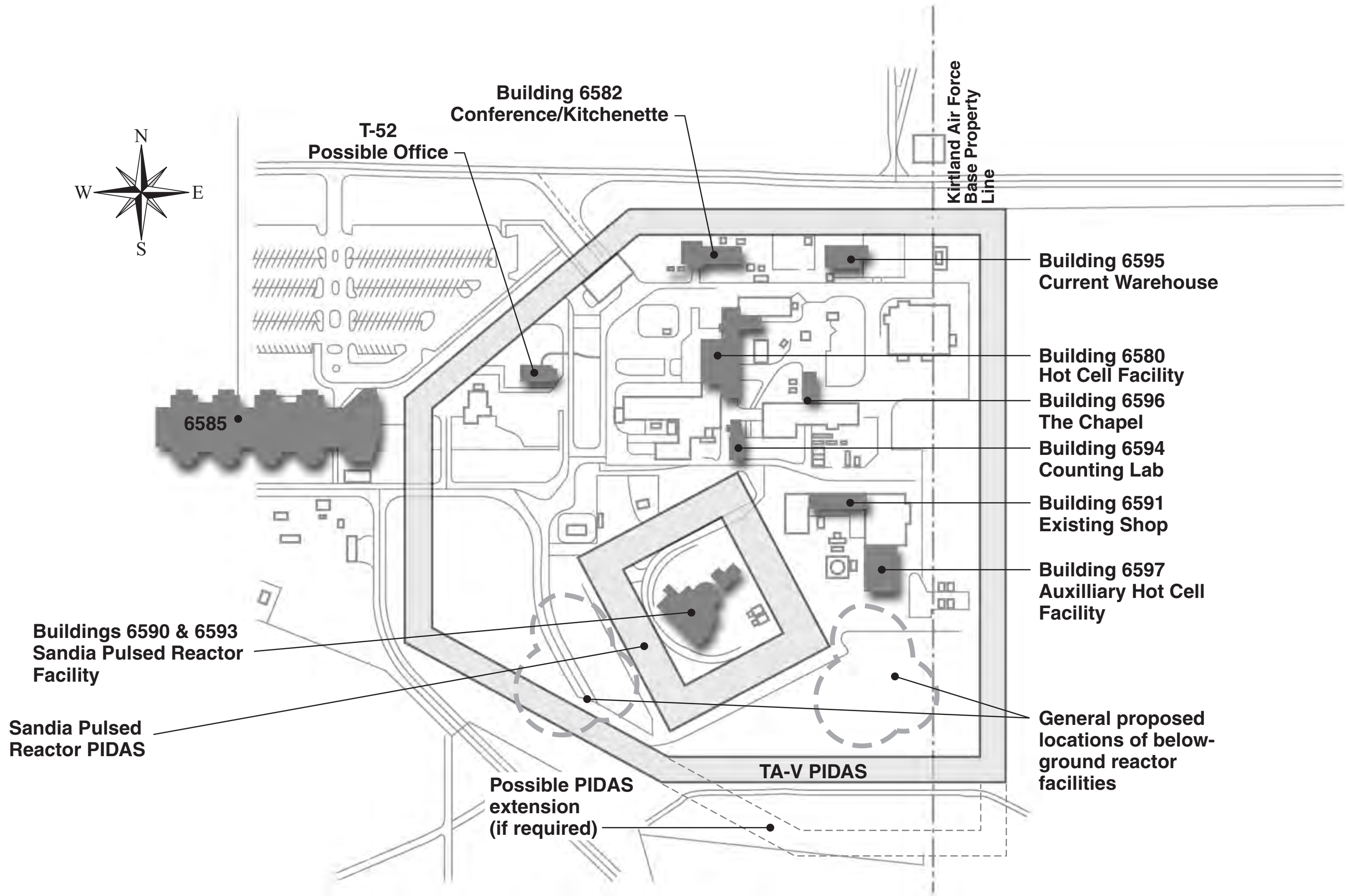

Figure S–7 Proposed New SNL/NM Facility and Existing Facilities (SNL/NM Alternative)

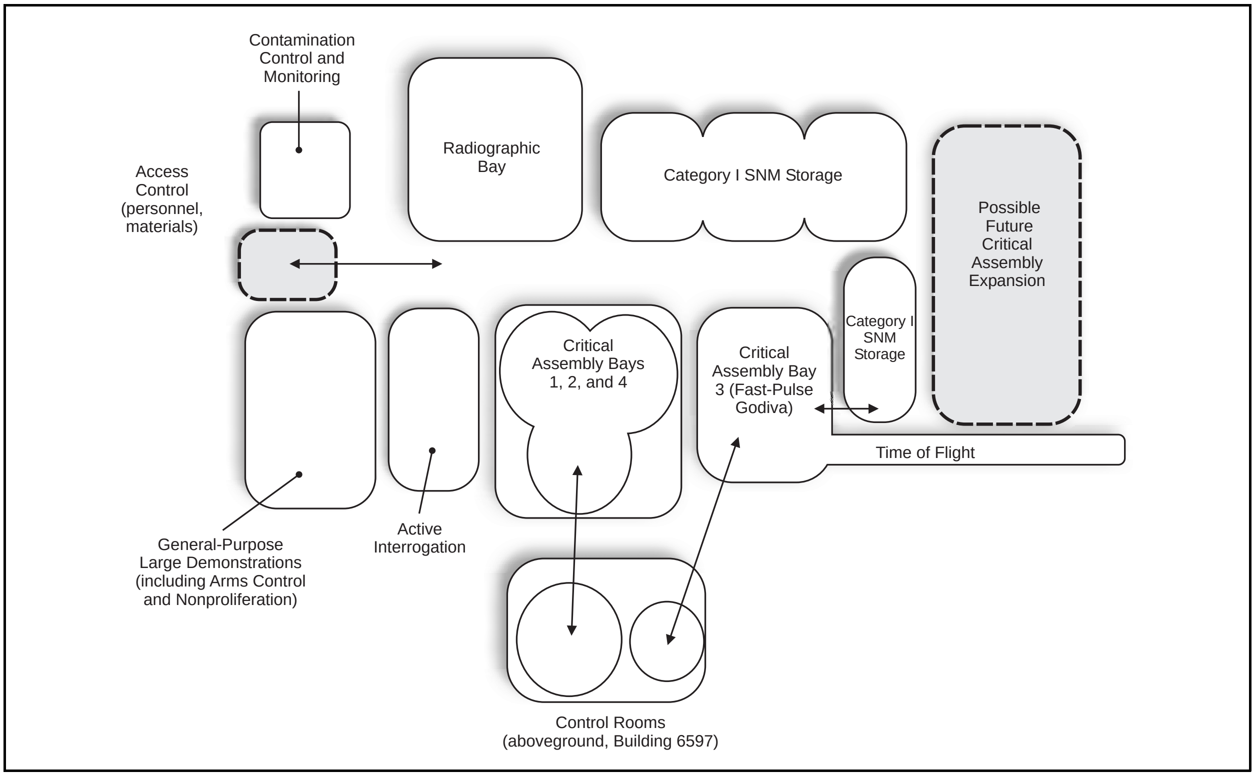

Figure S–8 Schematic of the Underground Facility (SNL/NM Alternative)

Facilities

Device Assembly Facility

DAF is a 9,290-square-meter (100,000-square-foot) nuclear explosive facility within a 12-hectare (29-acre) high security area, located in Area 6 of DOE's NTS (see **Figure S–9**). Construction on DAF began in the mid-1980s, when nuclear weapons testing was still in progress. DAF's original purpose was to consolidate all nuclear explosive assembly functions and to provide safe structures for high-explosive and nuclear explosive assembly operations, as well as a state-of-the-art safeguards and security environment.

DAF has five assembly cells, four high bays, three assembly bays, five staging bays, a component testing laboratory, two shipping and receiving buildings, two decontamination facilities, three small vaults, an administration building, alarm stations, an entry guard station, and a mechanical and electrical support building (see **Figure S–10**).

The main facility is covered with a minimum of 1.5 meters (5 feet) of earth. The major operating facilities, assembly cells and bays, radiography bays, and shipping and receiving building have bridge cranes. Each without injury to personnel outside of the cell. Gravel covers are designed to minimize release of nuclear material in the unlikely event of an accidental explosion.

One face of DAF is exposed and opens onto the area enclosed within a PIDAS security fence. DAF has a comprehensive security system designed into the structure.

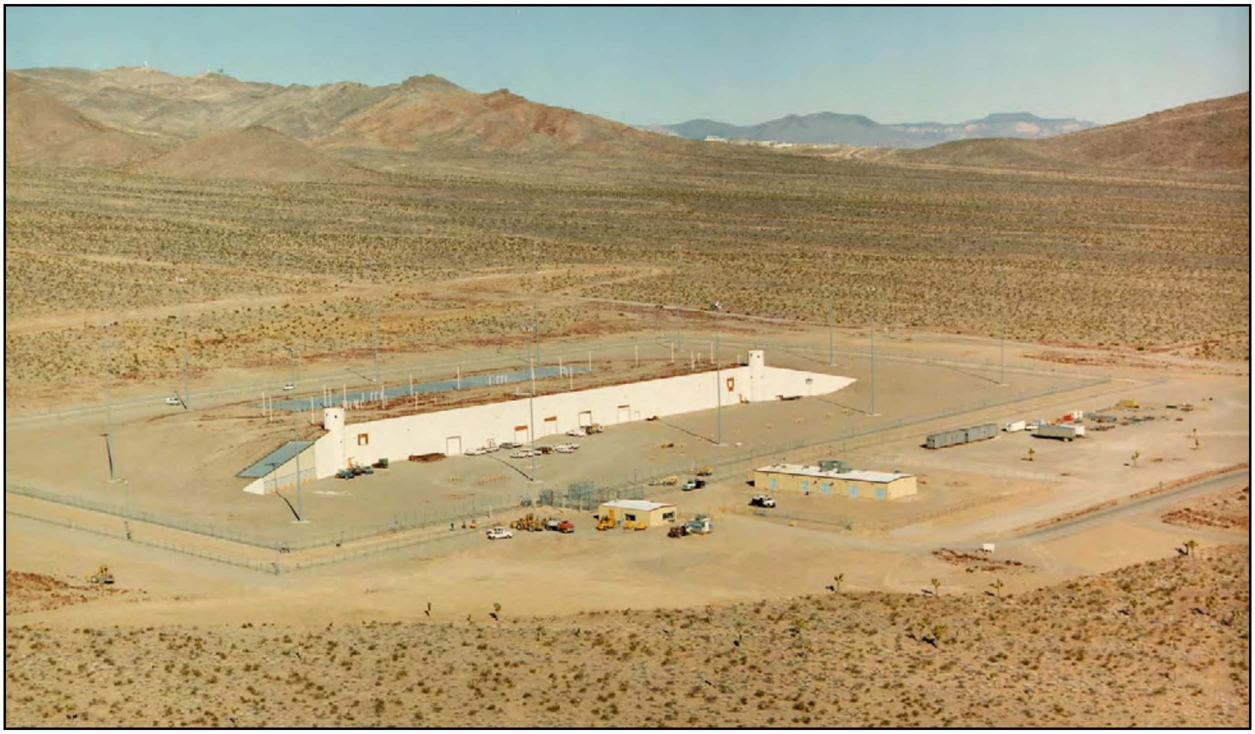

Figure S–9 DAF at NTS

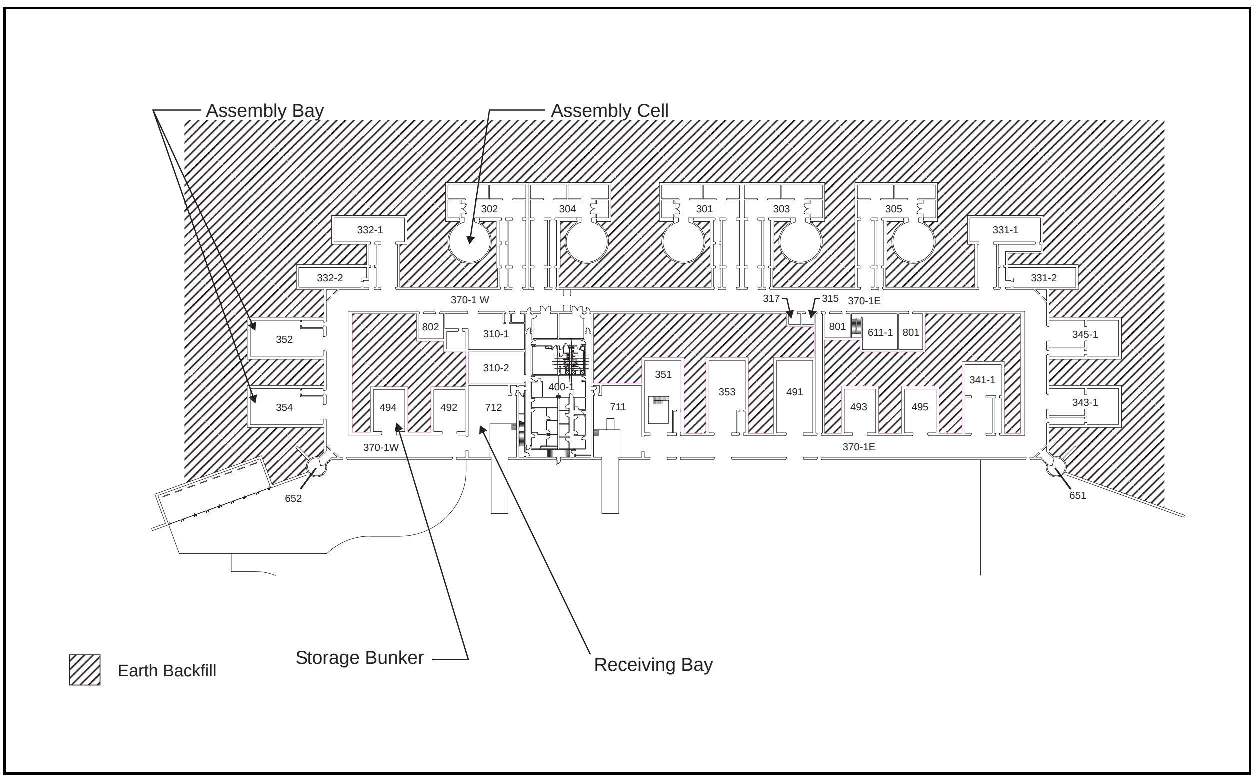

Figure S–10 DAF Floor Plan

The TA-18 security Category I/II operational activities would occur in the west side of Building 400. The building east of Building 400 is currently nonoperational and kept in "ready-reserve" status. The current missions in this building would be relocated to the east side of the building. **Figures S–11** and **S–12** show the proposed changes to accommodate the TA-18 activities.

The Building 370 corridor would remain in its present configuration with no equipment located within the corridor. The corridor is an unoccupied area, with administratively controlled access during normal operations.

A DAF Central Control Station would be placed in Building 400, allowing a readout of building status; fire and radiation alarm annunciation; weather reports on lightning; intercom and closed-circuit television control; and status of the individual heating, ventilating, and air conditioning systems.

Modifications inside DAF would include:

- Local modifications to internal walls, floors, and ceilings
- Local additions of bulk and penetration-shielding materials
- Local demolition of fire-suppression and other water systems
- Removal of polar cranes from assembly cells
- Raceway additions connecting the critical assemblies to their control rooms and power supplies
- Implementation of a DAF Central Control Station
- A new line-of-sight corridor internal to DAF

Buildings 302, 310, and 352 would be used to house the critical assembly machines and associated control rooms. Buildings 492 and 494 would be used for SNM storage.

New Low-Scatter Building

Because DAF is designed for blast protection, the buildings are constructed using massive concrete and steel surrounded by earthen fill. This is not compatible with one TA-18 activity that requires low reflectance from the surrounding walls, ceiling, and floor. The only acceptable way to meet this requirement would be to place this activity outside of DAF in a new "thin-skin," or "low-scatter," building. This low-scatter building would consist of a thin metal building and basement to prevent floor and wall radiation scatter. The low-scatter building would be placed in a location outside the DAF PIDAS.

The TA-18 radiography function would be accommodated in the existing DAF radiography building.

New Administration Building

The personnel currently in Building 400 would be displaced to allow room for the DAF Central Control Station, Radiation Control Technician work area, Hot Work Laboratory, Document Control Center, and a screening entrance to the Material Accountability Area boundary. This displacement of personnel would require a new Administrative Building outside the PIDAS. The new 1,115-square-meter (12,000-square-foot) facility would house personnel, provide conference facilities, allow space for storage of materials, and house emergency response equipment.

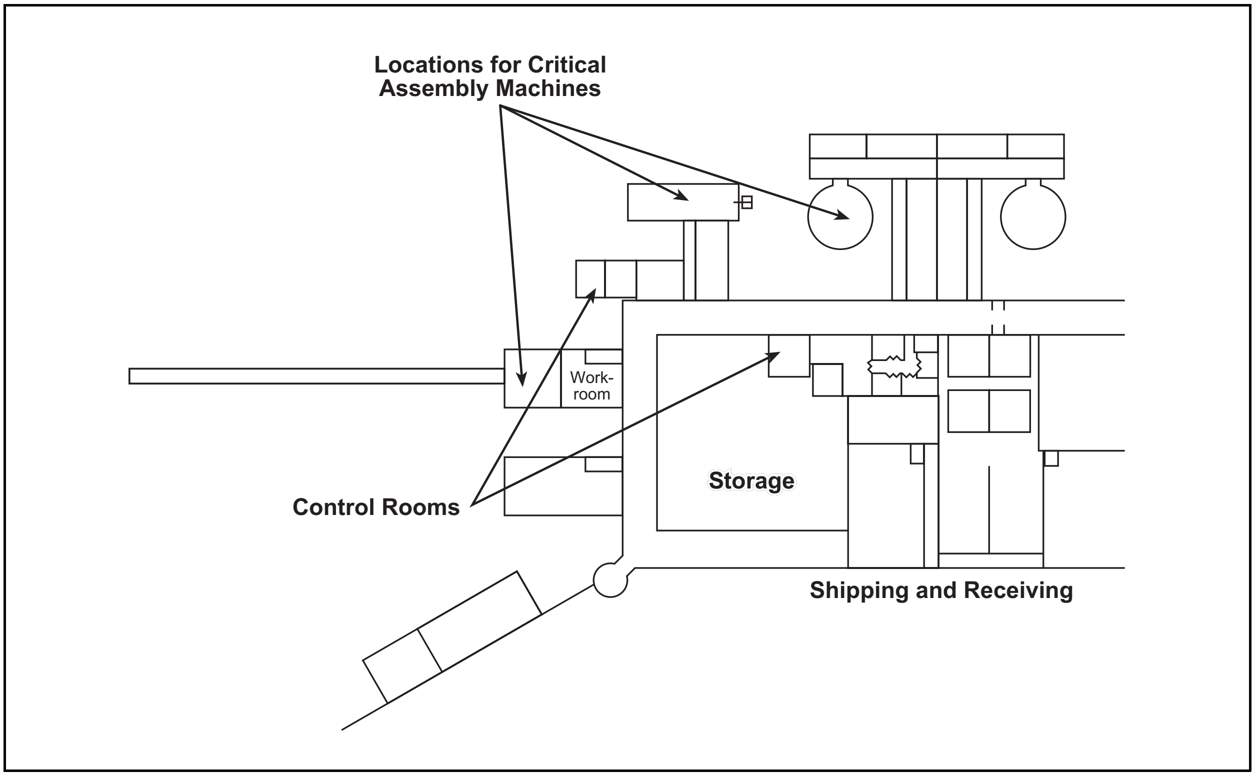

Figure S–11 DAF Critical Assembly Layout

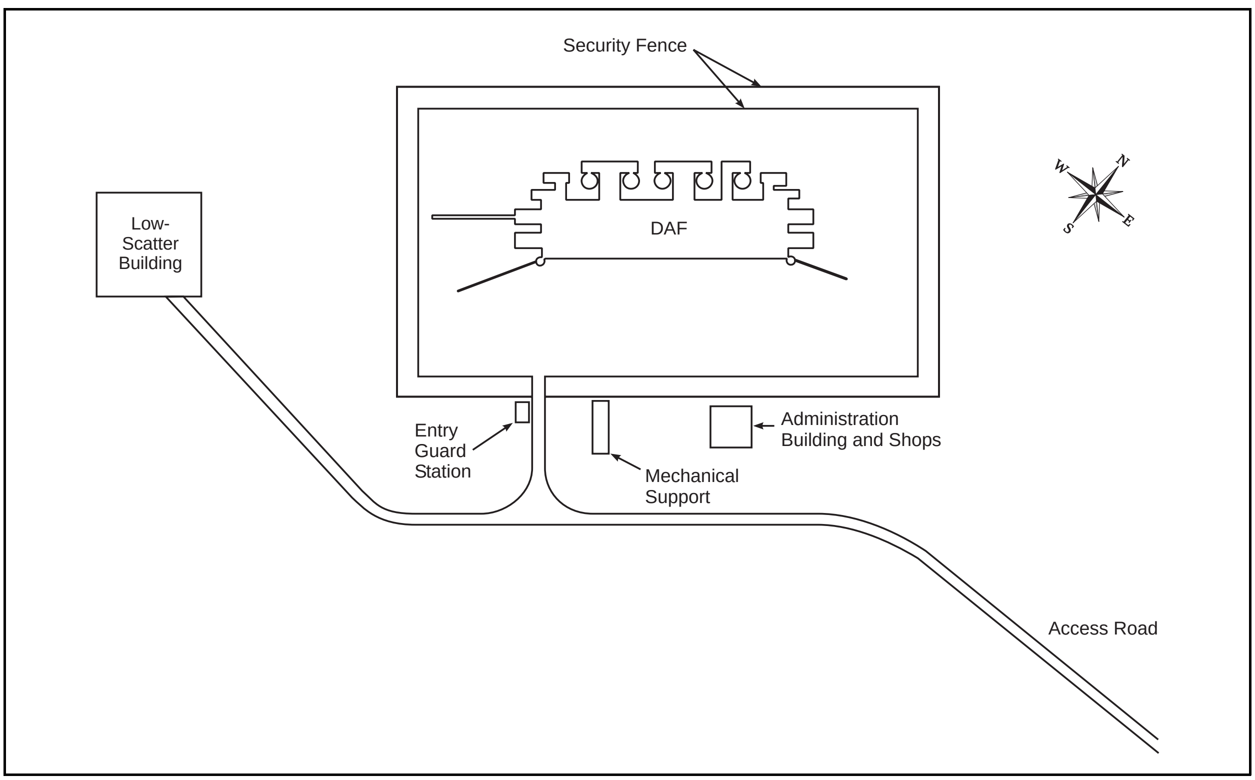

Figure S–12 DAF Layout Site Vicinity

S.3.2.6 ANL-W Alternative

This alternative would involve the housing of TA-18 operational capabilities and materials associated with security Category I/II activities in buildings located at ANL-W. The buildings proposed for the relocation of security Category I/II activities are: FMF, with a proposed addition; the Zero Power Physics Reactor (ZPPR) facility; the Experimental Breeder Reactor-II (EBR-II) containment and power plant; the Transient Reactor Test (TREAT) facility, and a new General-Purpose Experimental Building (GPEB). The site plan is shown in **Figure S–13**. Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at LANL's TA-39 or remain at TA-18. The rest of the security Category III/IV activities would remain at TA-18 (see Section S.3.2.7).

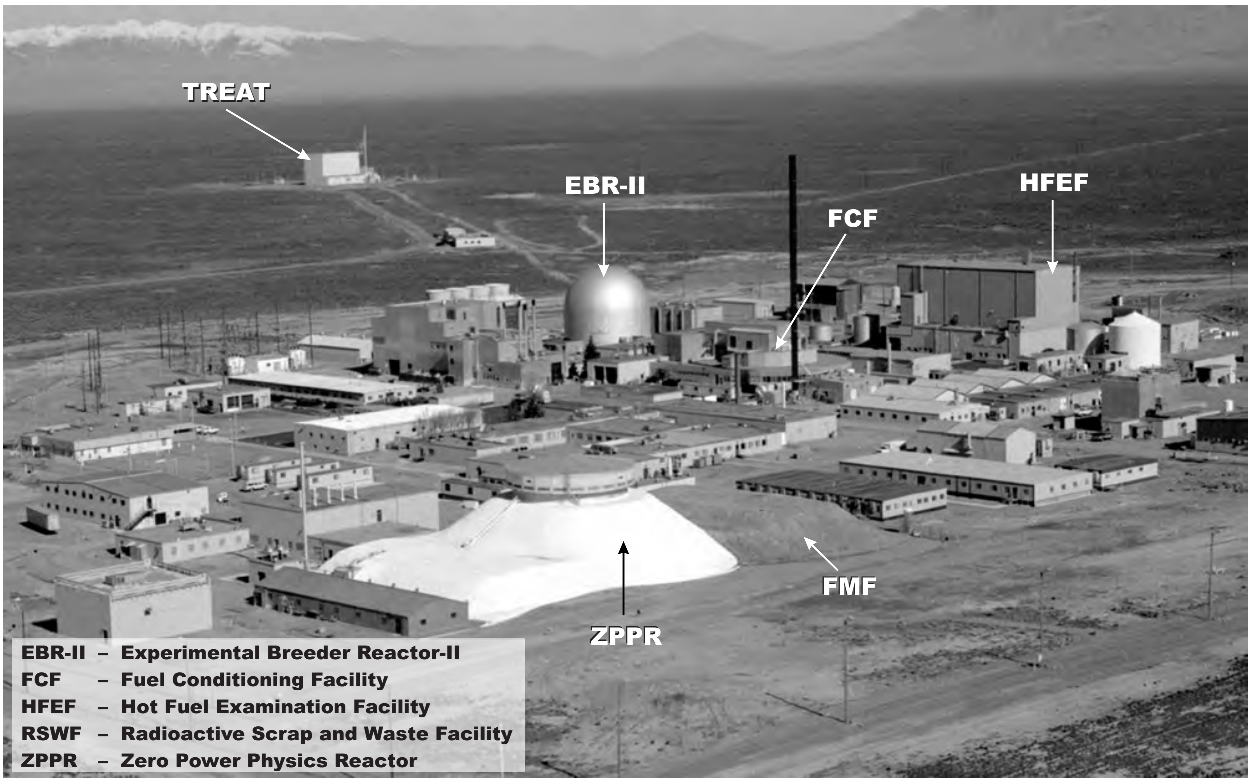

Figure S–13 ANL-W Site

One critical assembly machine would be housed in the ZPPR cell with the control room collocated with the ZPPR control room. The control rooms would be located in the ZPPR support wing (Building 774), inside the protected area. Three other critical assemblies would be located in a new addition to FMF (Building 704). Control rooms would be located in the basement of the ZPPR support wing (Building 774), which is outside of the protected area (see **Figure S–14**).

The EBR-II containment building would be used for radiography equipment. The truck lock located in the EBR-II power plant would be used for the emergency response staging area.

The low-scatter facility would be located on either the turbine floor of the EBR-II Power Plant (Building 768) or at the north end of the TREAT Reactor Building (Building 720).

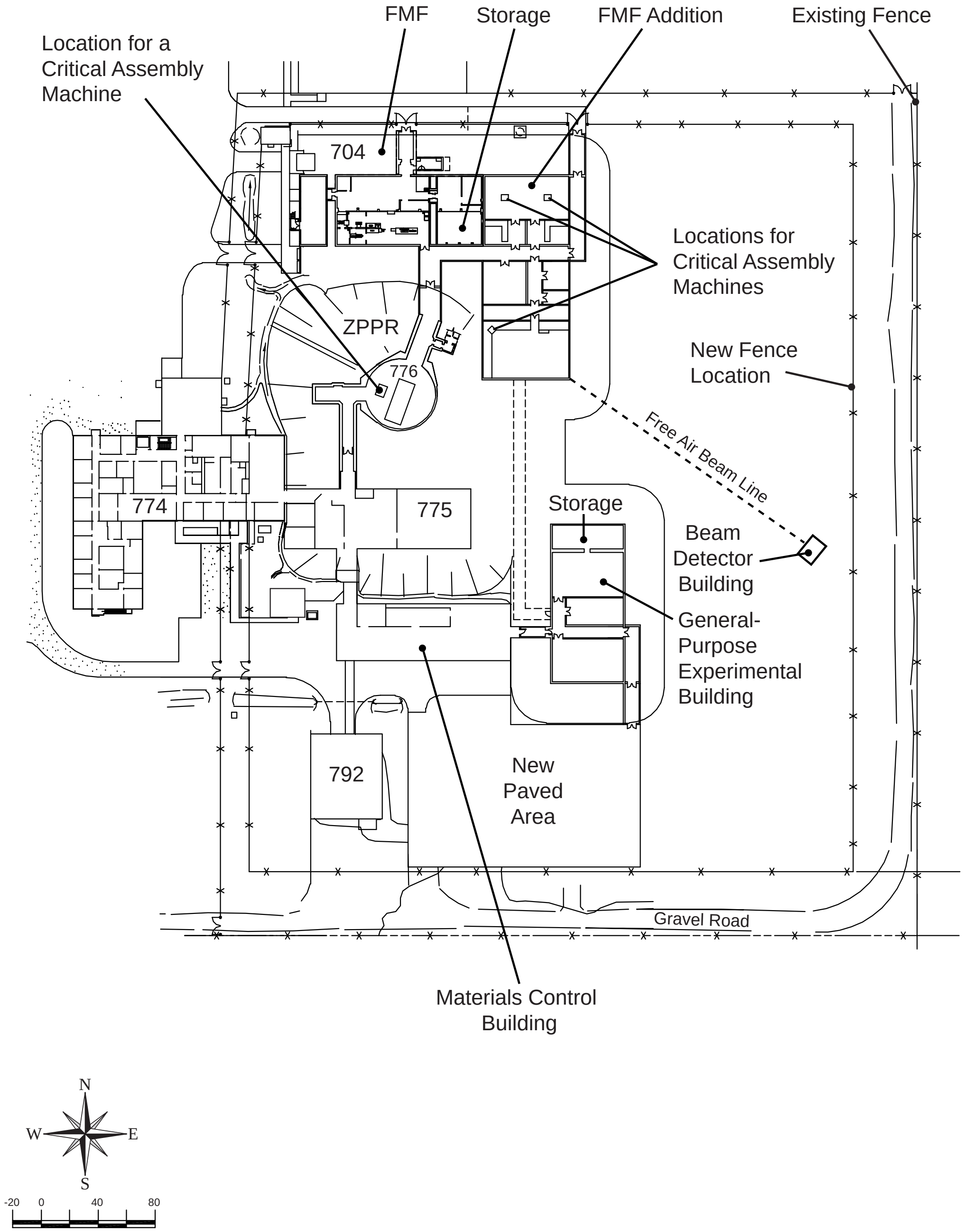

Figure S–14 Proposed Relocation Layout (ANL-W Alternative)

Storage vault space requirements for security Category IB SNM would be provided in four different vaults within the protected area. Two of the vaults currently exist, while the other two would be constructed along with the new additions.

Facilities

Fuel Manufacturing Facility

FMF (Building 704) is located adjacent to the ZPPR facility (see **Figure S–15**) and is covered with an earthen mound. FMF was used to manufacture fuel for EBR-II. The facility was completed in 1986 and was oversized for the EBR-II mission. The building includes a large SNM vault, an induction furnace, and gloveboxes and hoods, as well as other temporary experimental setups.

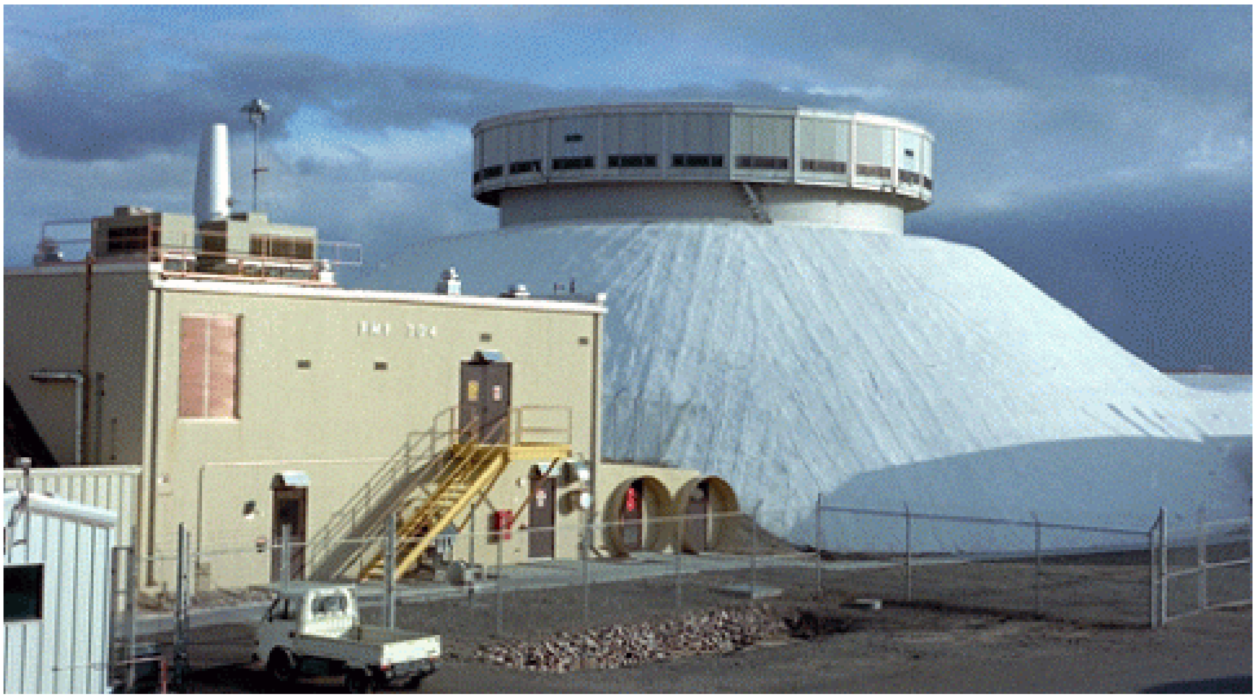

Figure S–15 FMF and ZPPR Facilities

Zero Power Physics Reactor

One of the critical assembly machines would be located in the reactor cell room of ZPPR (Building 776). It would share floor space in the reactor cell room with the existing ZPPR matrix. The material and equipment staging area for the machine would be located in Building 776, which is an alcove to the west of the reactor cell room. Space for instrumentation would be located in the workroom in Building 775.

The ZPPR facility was built to allow the mock-up of full-sized breeder reactor cores using critical assemblies with full plutonium loadings. The facility includes a refined "Gravel Gertie" building, a type of construction originally designed for handling nuclear weapons. The principal experimental area has a very thick foundation and thick concrete walls covered with an earthen mound and a sand/gravel/high-efficiency particulate air filter roof. In addition to being explosion-resistant, the facility was designed to safely contain a fire involving a full breeder reactor core loaded with more than 2.7 metric tons (3 tons) of plutonium.

The ZPPR vault is located in Building 775, which is just south of the Building 776 ZPPR reactor cell within the protected area. ZPPR is currently in a nonoperational standby status. The ZPPR fuel inventory remains on the ANL-W site, and the ZPPR vault/workroom remains operational to support nuclear materials storage in the ZPPR vault. The stainless steel matrix and the support structure that make up the core, i.e., the critical assembly structure, remain in the reactor cell and are essentially uncontaminated and inactivated.

Experimental Breeder Reactor-II

The EBR-II containment building (Building 767) would be used for locating radiography equipment. The EBR-II facility is shown in **Figure S–16**.

Transient Reactor Test Facility

Two locations have been identified that would be suitable for the low-scatter facility. One location is on the third floor of the power plant building, and the second is in the north end of the TREAT reactor building (Building 720). The TREAT facility is shown in **Figure S–17**. A removable, elevated catwalk would need to be constructed for this purpose.

TREAT is an air-cooled, thermal heterogeneous test facility designed to evaluate reactor fuel and structural materials under conditions simulating various types of transient overpower and undercooling situations in a nuclear reactor. The TREAT complex comprises reactor and control buildings located within a mile to the northwest of the main ANL-W protected area at the ANL-W site. The TREAT facility is located within its own security Category II protected area. To better accommodate program activities temporarily performed in the building, the TREAT protected area is currently administered as security Category III, but authorization for security Category II operation remains.

New General-Purpose Experimental Building

To support detector development, research and development, training, and technology demonstrations, a new security Category I GPEB would be constructed. GPEB would be located next to the Materials Control Building (Building 784), with a new paved area to support material transportation vehicles (see Figure S–14). Additional vault space for large items would be provided in GPEB.

New FMF Addition

An addition to FMF would be constructed to locate three of the critical assemblies (see Figure S–14). The FMF addition would use the same beamed structural design as FMF. The facility structure, as well as the ventilation, would constitute the confinement system of the FMF addition.

The FMF addition would have exterior dimensions of 44 meters (145 feet) long (north-south) and 19 meters (62 feet) wide (east-west). The facility would be accessed by a new access tunnel starting from the ZPPR reactor cell and traveling to the west side of the addition. An escape tunnel would be located on the east side of the facility leading to a grated area. Security doors would be installed in the new tunnel extension from ZPPR and the escape tunnel.

Figure S–16 EBR-II Facility

Figure S–17 TREAT Facility

S.3.2.7 Relocation of SHEBA and Other Security Category III/IV Activities

The TA-18 SHEBA and other security Category III/IV activities would either be relocated to TA-39 and TA-55, respectively, or remain at TA-18. The locations of TA-39 and TA-55 within LANL are shown in **Figure S–18**.

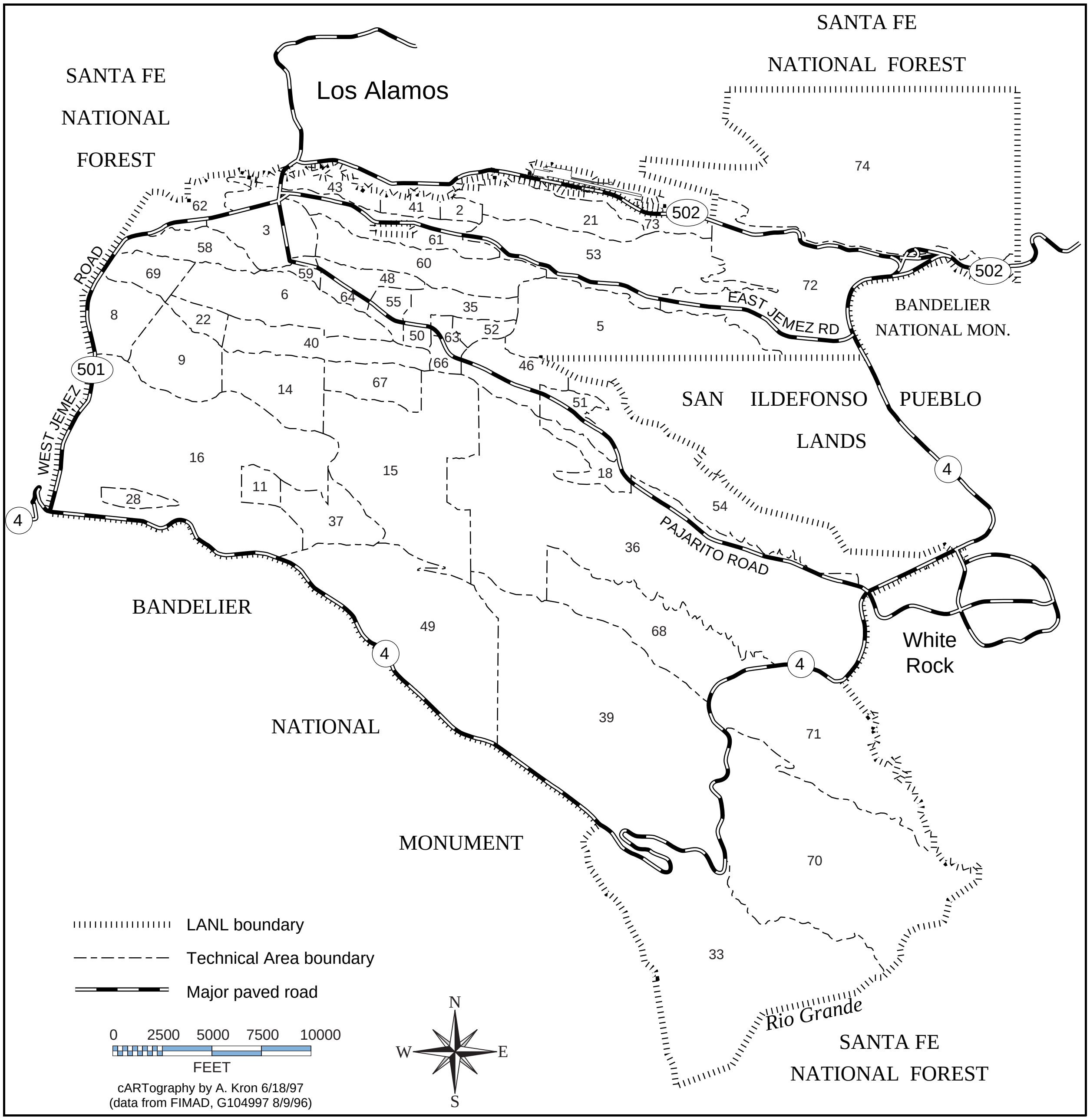

Figure S–18 Technical Areas at LANL

S.3.2.7.1 Siting Selection for SHEBA

SHEBA and other security Category III/IV activities are currently conducted at TA-18. A major distinguishing characteristic of the SHEBA criticality machine is that it is used to test and calibrate criticality alarm detectors and personal dosimeters. This use requires that the SHEBA machine is operated in a "free-field" environment, i.e., with no radiation shielding. Because TA-18 is very close to the heavily traveled Pajarito Road, many SHEBA operations must be performed at nighttime and require Pajarito Road to be closed. Leaving SHEBA at its current location would offer little advantage, especially if security Category I/II activities were relocated, as the ongoing cost of maintaining an aging infrastructure could exceed the capital costs for new facilities.

To minimize the potential exposure to members of the public and collocated, uninvolved workers, some SHEBA operations require Pajarito Road to be closed and a minimal site occupancy at TA-18. A new site that limits public access would allow experiments to be conducted during normal working hours. Maintaining a distance to the public of 800 to 1,000 meters (875 to 1,094 yards) is desirable to limit the requirement for safety-class structures, systems, and components. SHEBA operations require the ability to be controlled remotely, thereby necessitating a control building from which to operate the SHEBA assembly.

On the other hand, the operations require simple structures with the usual utilities, such as electricity, water, sewer, and compressed air.

The initial set of technical area criteria for siting SHEBA included relatively low population densities and some utilities. TA-39 was identified as the site for the relocation of SHEBA activities because of its remote location and the availability of existing facilities and utilities that would reduce construction costs. While once used extensively for explosives testing, most of this activity at TA-39 has been transferred to other locations at LANL. Therefore, relocating SHEBA activities to TA-39 would require only a moderate amount of coordination with other existing site activities. A brief discussion of other sites at LANL that were evaluated for the relocation of SHEBA activities and the reasons they were not considered for detailed analysis follows:

TA-16—The main deficiency of the TA-16 site is that substantial development of this general area ("Experimental Engineering") is planned. The *LANL Comprehensive Site Plan 2000* specifies that this area is scheduled to contain tritium facilities, explosives facilities, and facilities related to the Advanced Hydrotest Facility. Locating SHEBA in this area would hinder these developments as well as SHEBA's operational efficiency.

TA-49—Proximity to the public is the main deficiency of this site. State Highway 4 is only 500 meters (547 yards) away from this site, and LANL has no control over this state highway.

TA-36—Current and planned use of this area for high-explosives testing is the main deficiency of this site. The high frequency of planned explosives testing would severely impact SHEBA's operational efficiency.

TA-33—This site has several significant deficiencies. The utilities in this area are very limited, the site is close to a popular trail leading to the Rio Grande Valley, and, on several occasions, hikers have walked up into the area.

S.3.2.7.2 Facilities

The relocation of the SHEBA activities to TA-39 would involve the construction of a new structure on top of an existing bunker (Building 6 at TA-39) or the construction of a new bunker and cover structure at another suitable location at TA-39. The bunker, in both cases, would be used to house the SHEBA solution tanks and support equipment. A new control and training-room structure would either be built along the existing road leading to Building 6 at TA-39, or in relatively close proximity to the construction of the new SHEBA bunker. In either case, it would be outside the SHEBA radiation and existing explosives magazines exclusion zones. Water and gas would be extended to this building, along with the installation of a septic tank and leach field. The location of the existing Building 6 at TA-39 proposed for the relocation of SHEBA is shown in **Figure S–19**.

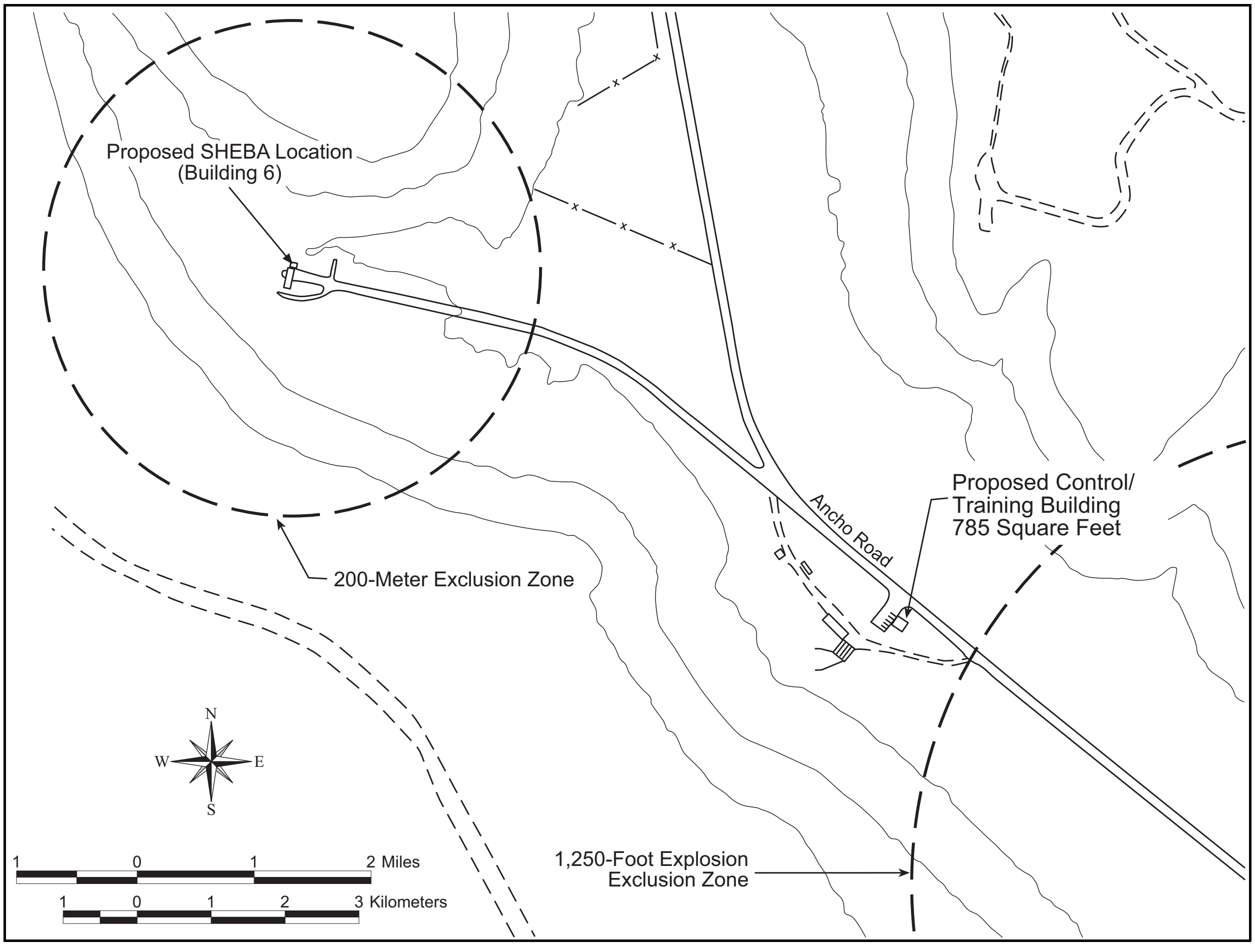

Figure S–19 Location of the Proposed Facilities for the Relocation of SHEBA at LANL's TA-39

The relocation of the security Category III/IV activities to LANL's TA-55 would involve the construction of a new laboratory and a new office building at TA-55 in the proximity of the proposed new underground facility for security Category I/II activities, but outside the PIDAS. The location of these two buildings for the relocation of security Category III/IV activities at LANL's TA-55 is shown in **Figure S–20**. If a decision is made that security Category III/IV activities remain at TA-18, some internal modifications to TA-18 facilities would be required, but no new construction. Internal modifications would be limited to rearrangement of internal spaces to accommodate the security Category III/IV activities.

S.3.3 Alternatives Considered and Dismissed

Discontinue TA-18 Missions

As discussed in Section S.1.1, the operations conducted at TA-18 are vital to DOE's mission requirements and must be maintained. This determination is consistent with independent reviews made by the Defense Nuclear Facilities Safety Board. In separate 1993 and 1997 studies of the TA-18 missions, the Defense Nuclear Facilities Safety Board recommended that DOE continue to maintain the capability to support the

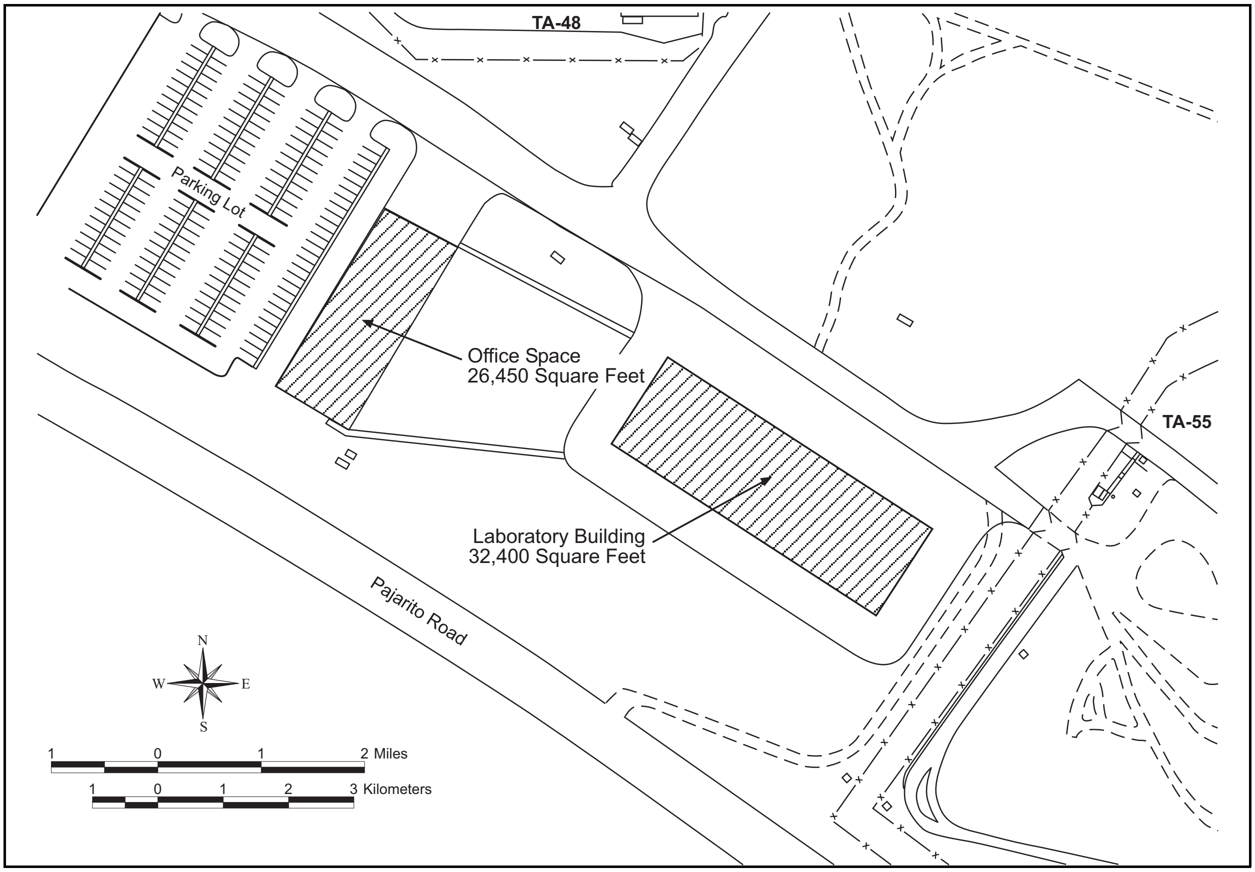

Figure S–20 Location of the Proposed Facilities for the Relocation of Security Category III/IV Activities at LANL's TA-55

only remaining criticality safety program in the Nation. Few or none of DOE's nuclear programs could ensure their safe execution without the continued training, expertise, and calibration experiments that are available at a general-purpose criticality experiments facility. This alternative did not meet DOE's need for action and was not analyzed further in this EIS.

Alternative Sites

During the initial screening process, all DOE sites were considered for the relocation of TA-18 operational capabilities and materials. The DOE sites that did not pass the screening criteria were Rocky Flats, Hanford, INEEL, and Brookhaven National Laboratory. In addition to the DOE sites, possible relocation to U.S. Department of Defense installations was considered. However, there were serious concerns regarding long-term mission compatibility and security Category I requirements; therefore, Department of Defense sites were removed from further consideration for this EIS.

All DOE sites that passed the initial screening criteria were sent a request-for-proposal package that described the TA-18 missions and high-level functional requirements. Each site was asked to submit a response to the proposal request. Five sites—Pantex (Amarillo, Texas), the Y-12 Plant (Oak Ridge, Tennessee), Oak Ridge National Laboratory (Oak Ridge, Tennessee), the Savannah River Site (Aiken, South Carolina), and Lawrence Livermore National Laboratory (Livermore, California)—were eliminated from further consideration because they did not submit a response that met the detailed site selection criteria.

The potential use of the existing Nuclear Material Storage Facility (NMSF) at TA-55 at LANL was evaluated for partial fulfillment of the TA-18 Relocation Project requirements. The evaluation included consideration of the use of NMSF for three critical assembly machines (excluding Godiva) and existing tunnels or other NMSF spaces for nuclear material storage. It was concluded that the TA-18 missions would not fit well into NMSF and its use would still require a new building to be constructed. Such a proposal would require increased capital and operational costs.

S.4 AFFECTED ENVIRONMENT

Los Alamos National Laboratory

LANL is located on 11,272 hectares (27,832 acres) of land in north central New Mexico (**Figure S–21**). The site is located about 97 kilometers (60 miles) north-northeast of Albuquerque, 40 kilometers (25 miles) northwest of Santa Fe, and 32 kilometers (20 miles) southwest of Española. LANL is owned by the Federal Government and administered by DOE's NNSA. It is operated by the University of California. Portions of LANL are located in Los Alamos and Santa Fe Counties. DOE's principal missions at LANL are national security, energy resources, environmental quality, and science.

LANL is divided into 49 separate technical areas with location and spacing that reflect the site's historical development patterns, regional topography, and functional relationships. While the number of structures changes somewhat with time (e.g., as a result of the recent Cerro Grande Fire; see Section 4.2.1.1 of the EIS), there are 944 permanent structures; 512 temporary structures; and 806 miscellaneous buildings with approximately 465,000 square meters (5,000,000 square feet) that could be occupied. In addition to onsite office space, 19,833 square meters (213,262 square feet) of space is leased within the Los Alamos townsite and White Rock community.

TA-18, which is centrally located within LANL, is the current location of the Los Alamos Critical Experiments Facility. Facilities within this technical area study both static and dynamic behavior of critical assemblies of nuclear materials. SNM are used to support a wide variety of activities for stockpile management, stockpile stewardship, emergency response, nonproliferation, and safeguards. In addition, this facility provides the capability to perform hands-on training and experiments with SNM in various configurations below critical.

TA-55 is one of the sites proposed for the relocation of operations currently performed at TA-18. TA-55 is located in the west-central portion of LANL. TA-55 facilities provide research and applications in chemical and metallurgical processes for recovering, purifying, and converting plutonium and other actinides into many compounds and forms, as well as research into material properties and fabrication of parts for research and stockpile applications. Additional activities include the means to safely and securely ship, receive, handle, and store nuclear materials, as well as manage the waste and residue produced by TA-55 operations.

Sandia National Laboratories/New Mexico

SNL/NM is located within KAFB, approximately 11 kilometers (7 miles) southeast of downtown Albuquerque, New Mexico (see **Figure S–22**). Albuquerque is located in Bernalillo County, in north central New Mexico, and is the state's largest city, with a population of approximately 420,000. The Sandia Mountains rise steeply immediately north and east of the city, with the Manzanita Mountains extending to the southeast. The Rio Grande runs southward through Albuquerque and is the primary river traversing central New Mexico. Nearby communities include Rio Rancho and Corrales, each located about 25 kilometers (15.5 miles) to the northwest. The Pueblo of Sandia and town of Bernalillo are located 34 kilometers (21 miles) and 39 kilometers (24 miles), respectively, to the north. The Pueblo of Isleta and

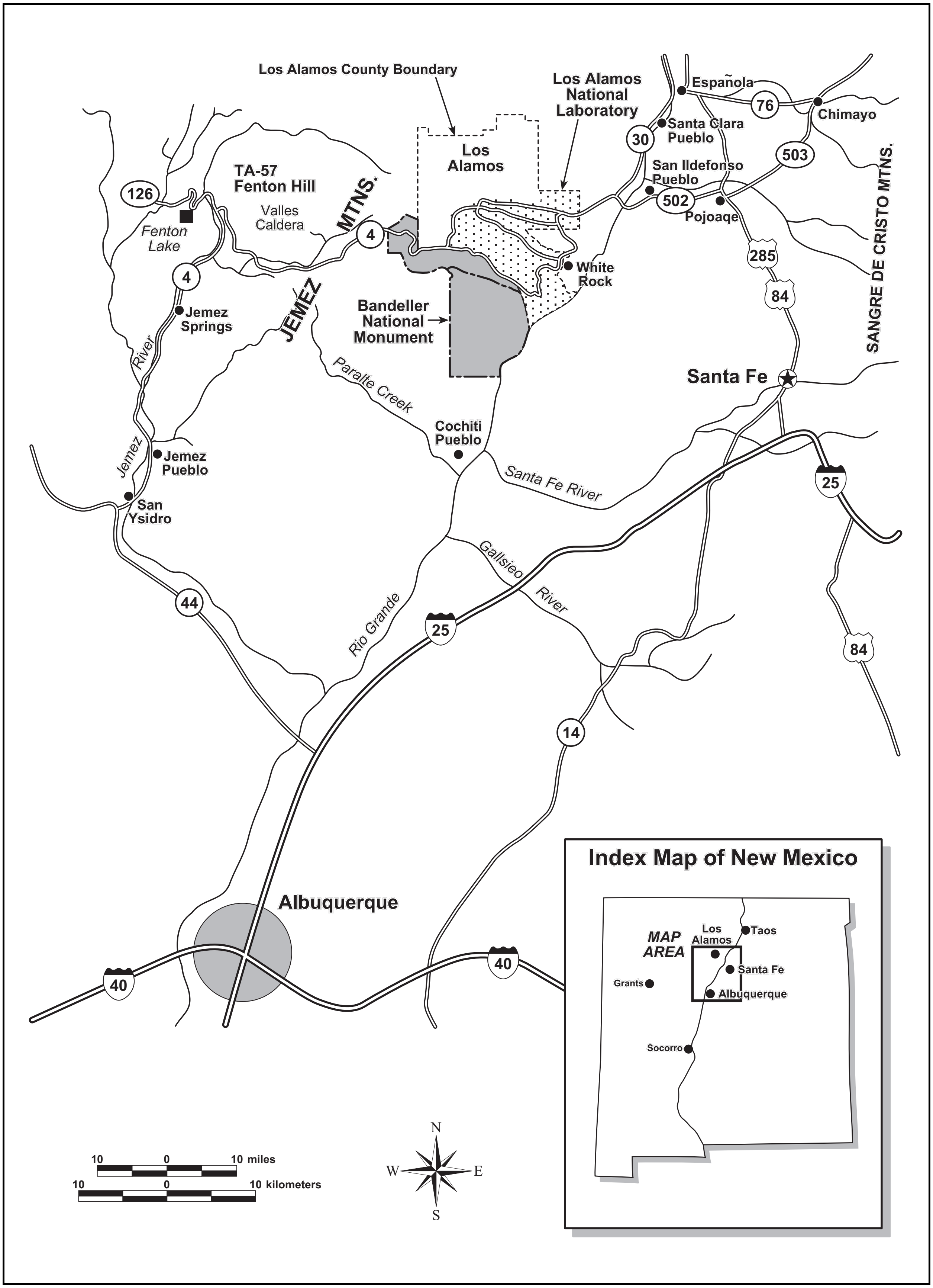

Figure S–21 Location of LANL

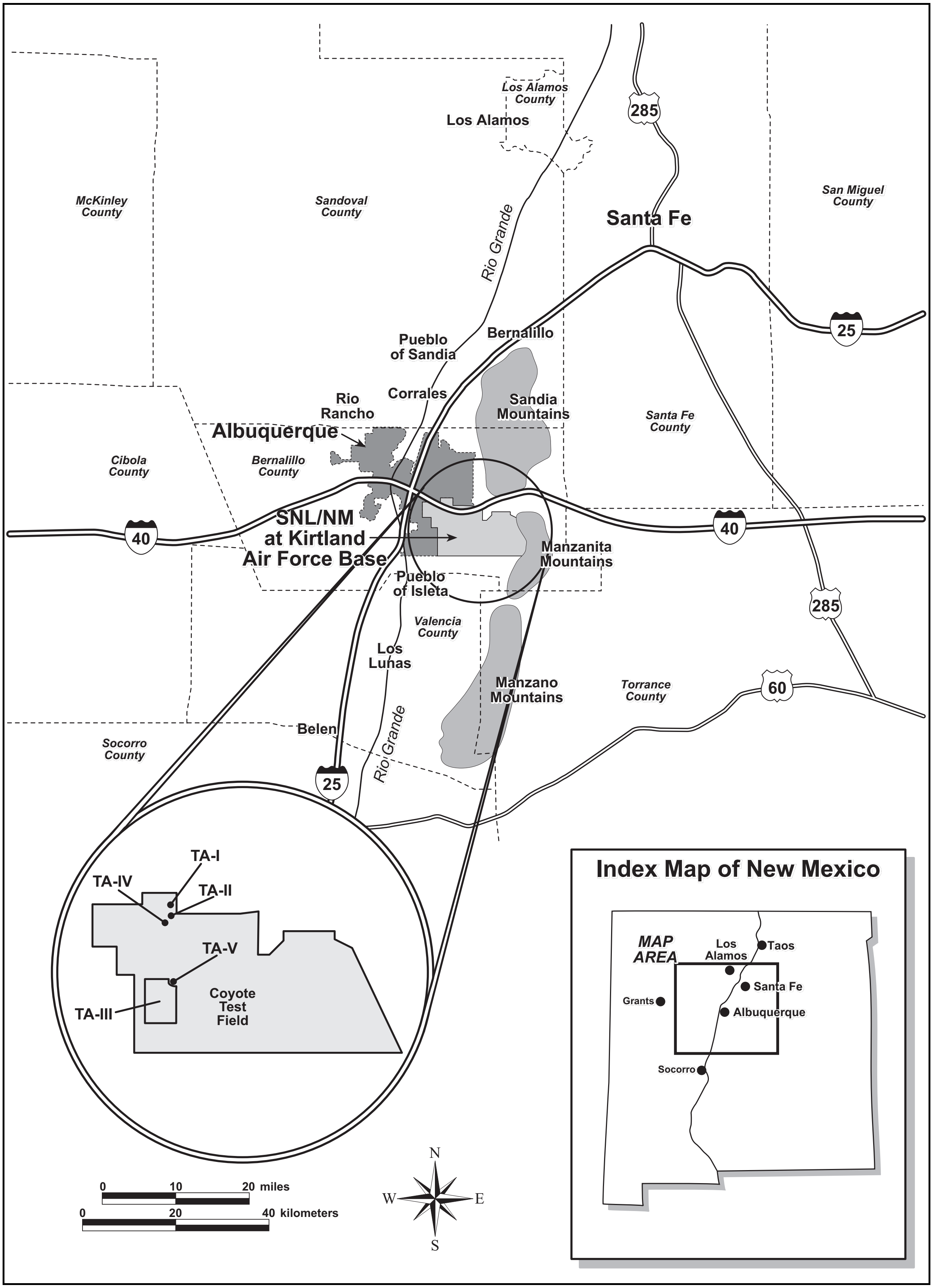

Figure S–22 Location of SNL/NM

towns of Los Lunas and Belen are located 17 kilometers (10.5 miles), 28 kilometers (17.5 miles), and 45 kilometers (28 miles), respectively, to the southwest.

SNL/NM uses approximately 3,560 hectares (8,800 acres) of Federal land on KAFB, which is administered by DOE's NNSA. There are approximately 670 buildings at SNL/NM, plus a number of structures associated with outdoor test areas. DOE missions at SNL/NM are conducted within five technical areas, as well as several outdoor test areas. Technical areas comprise the basic geographic configuration of SNL/NM (see Figure S–22). TA-I is the main administration and site support area and contains several laboratories. TA-II consists primarily of support service facilities along with the new Explosive Components Facility, several active and inactive waste management facilities, and vacated facilities replaced by the Explosive Components Facility. TA-III is devoted primarily to physical testing; TA-IV contains primarily accelerator operations; and TA-V contains primarily reactor facilities. The Coyote Test Field and the Withdrawn Area are used for outdoor testing.

Nevada Test Site

NTS is located on approximately 365,100 hectares (880,000 acres) in southern Nye County, Nevada. The site is located 105 kilometers (65 miles) to the northwest of Las Vegas and 16 kilometers (10 miles) northeast of the California State line (see **Figure S–23**). All of the land within NTS is owned by the Federal Government and is administered, managed, and controlled by DOE's NNSA. NTS contains approximately 900 buildings that provide approximately 259,300 square meters (2,790,600 square feet) of space. Many of these facilities have been either mothballed or abandoned because of the reduction of program activities at the site.

Approximately one-half of the land that makes up NTS (located in the eastern and northwestern portions of the site) has been used for nuclear weapons testing. One-quarter (located in the western portion of the site) is reserved for future missions, and one-quarter is used for research and development and other facility requirements. Programs conducted at NTS include those related to defense, waste management, environmental restoration, nondefense research and development, and work for others.

DAF is situated within the east-central portion of NTS. This area occupies about 21,200 hectares (52,500 acres) between Yucca Flat and Frenchman Flat, straddling Frenchman Mountain. The area was used for one atmospheric and five underground nuclear tests between 1957 and mid-1990.

Argonne National Laboratory-West

ANL-W is located within the boundaries of INEEL. Because of this, the general site description presented in this section is that of INEEL. INEEL is located on approximately 230,700 hectares (570,000 acres) in southeastern Idaho and is 55 kilometers (34 miles) west of Idaho Falls; 61 kilometers (38 miles) northwest of Blackfoot; and 35 kilometers (22 miles) east of Arco (see **Figure S–24**). INEEL is owned by the Federal Government and administered, managed, and controlled by DOE. It is primarily within Butte County, but portions of the site are also in Bingham, Jefferson, Bonneville, and Clark Counties. The site is roughly equidistant from Salt Lake City, Utah, and Boise, Idaho.

There are 450 buildings and 2,000 support structures at INEEL, with more than 279,000 square meters (3,000,000 square feet) of floor space in varying conditions of utility. INEEL has approximately 25,100 square meters (270,000 square feet) of covered warehouse space and an additional 18,600 square meters (200,000 square feet) of fenced yard space. The total area of the various machine shops is 3,035 square meters (32,665 square feet).

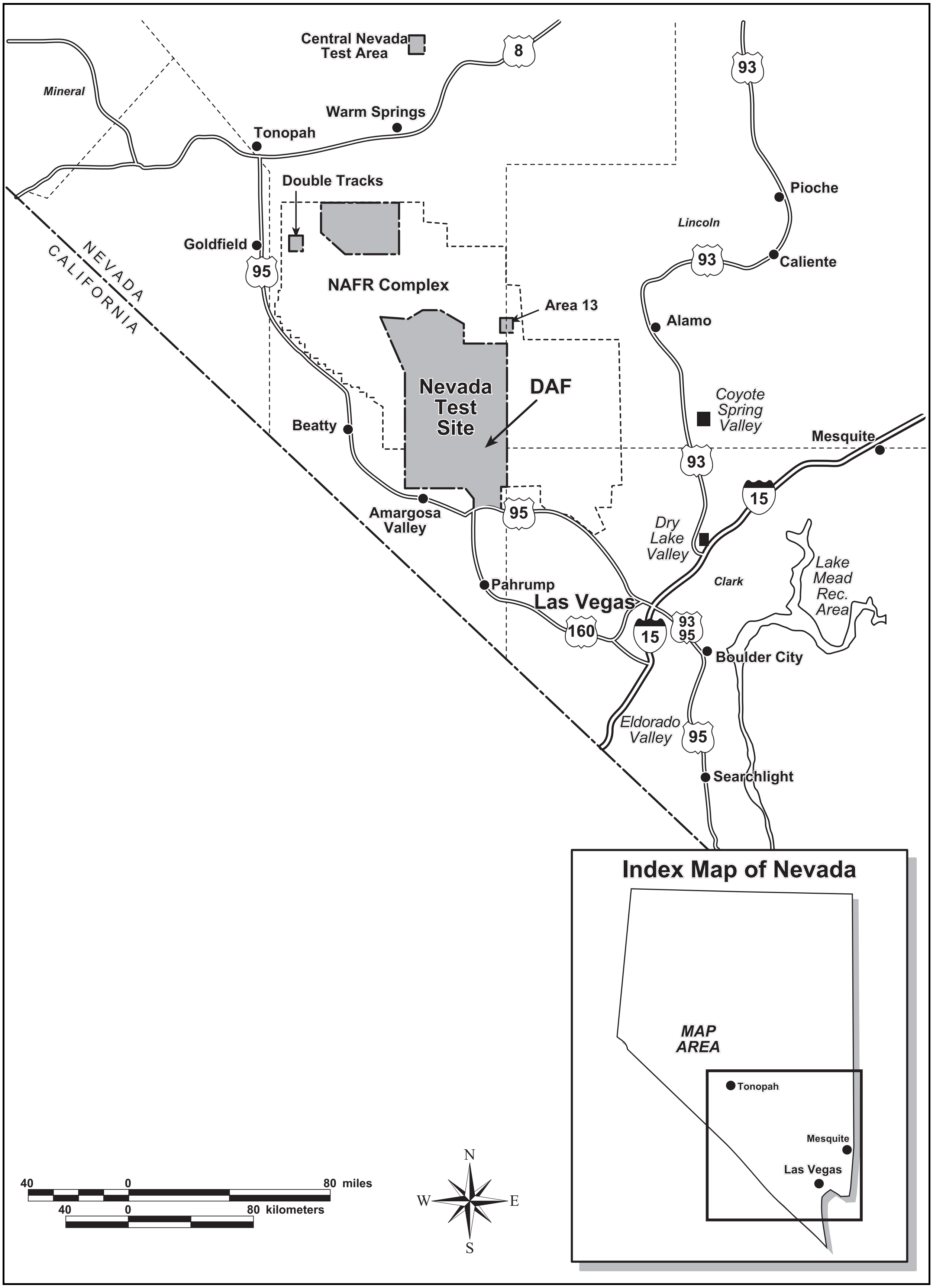

Figure S–23 Location of NTS

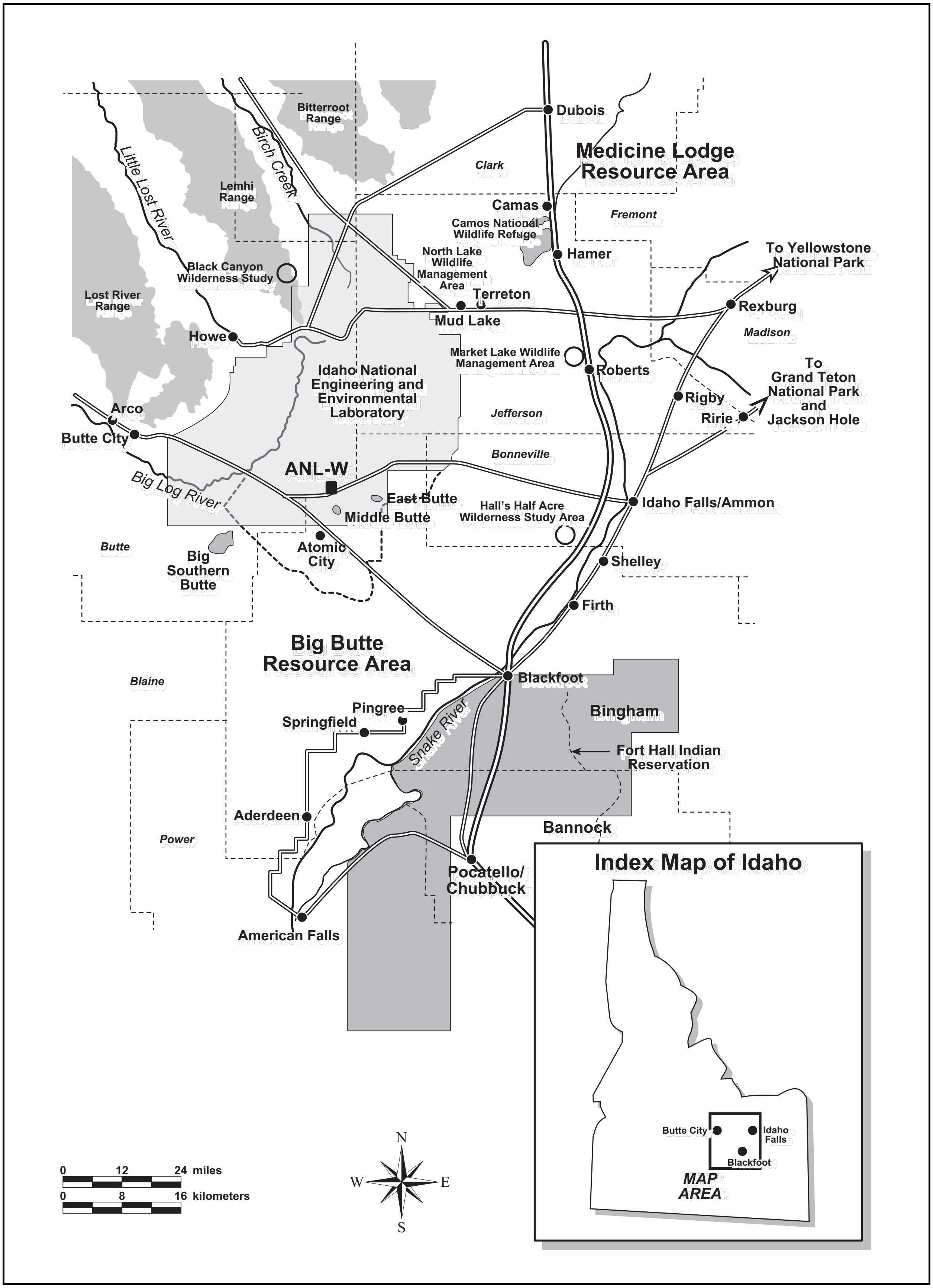

Figure S–24 Location of ANL-W

Fifty-two research and test reactors have been used at INEEL over the years to test reactor systems, fuel and target design, and overall safety. In addition to nuclear research reactors, other INEEL facilities are operated to support reactor operations. These facilities include high- and low-level radioactive waste processing and storage sites; hot cells; analytical laboratories; machine shops; and laundry, railroad, and administrative facilities. Other activities include management of one of DOE's largest storage sites for low-level radioactive waste and transuranic waste.

ANL-W is located in the southeastern portion of INEEL, about 61 kilometers (38 miles) west of the city of Idaho Falls. The site is designated as a testing center for advanced technologies associated with nuclear power systems. The area has 52 major buildings, including reactor buildings, laboratories, warehouses, technical and administrative support buildings, and craft shops that comprise 55,700 square meters (600,000 square feet) of floor space. Five nuclear test reactors have operated on the site, although the only one currently active is a small reactor used for radiography examination of experiments, waste containers, and spent nuclear fuel. Principal facilities located at ANL-W include FMF, TREAT, the Fuel Conditioning Facility, the Hot Fuel Examination Facility, ZPPR, and EBR-II (see Figure S–13).

S.5 PREFERRED ALTERNATIVE

Council on Environmental Quality regulations require an agency to identify its preferred alternative, if one or more exists, in the draft EIS (40 CFR 1502.14(e)). The preferred alterative is the alternative which the agency believes would fulfill its statutory mission, giving consideration to environmental, economic, technical, and other factors. When the former Secretary of Energy announced that DOE would prepare the *TA-18 Relocation EIS*, it was also announced that a new location at LANL to conduct the TA-18 operations and store associated materials was the Preferred Alternative (the LANL New Facility Alternative).

S.6 COMPARISON OF ALTERNATIVES

S.6.1 Introduction

To aid the reader in understanding the differences among the various alternatives, this section presents a summary comparison of the potential environmental impacts associated with the alternatives for the relocation of the TA-18 operational capabilities and materials. The comparisons concentrate on those resources with the greatest potential to be impacted.

The information in this section is based on the descriptions of each alternative presented earlier in this chapter. Because the potential environmental impacts associated with each of the alternatives can be described in terms of *construction impacts* and *operations impacts*, the potential impacts are compared in those two areas. **Table S–3** at the end of this chapter provides quantitative information that supports the text below. Table S–3 also includes the environmental impacts associated with the potential relocation of the SHEBA activities and other security Category III/IV activities to new structures at LANL (last two columns). These impacts should be considered in conjunction with the impacts involving the relocation of the TA-18 security Category I/II activities if SHEBA and/or other security Category III/IV activities do not remain at TA-18.

S.6.2 Construction Impacts

No Action Alternative—Under the No Action Alternative there would be no new construction or upgrades. Accordingly, there would be no potential environmental impacts resulting from construction for this alternative.

TA-18 Upgrade Alternative—Under the TA-18 Upgrade Alternative there would be minor construction impacts associated with upgrading the existing infrastructure and security at TA-18 to bring them into compliance with new and more stringent safety, security, and environmental standards. While most of the construction impacts would involve internal modifications to existing facilities, several new support facilities would be constructed, disturbing approximately 0.2 hectares (0.5 acres) of previously cleared land. The existing infrastructure would adequately support construction activities. Construction activities would result in potential temporary increases in air quality impacts, but these would be below ambient air quality standards. Construction activities would likely result in no or minor impacts on water, visual resources, biotic resources (including threatened and endangered species), geology and soils, or cultural and paleontological resources. The socioeconomic impacts associated with construction would not cause any major changes to employment, housing, or public finance in the socioeconomic region of influence. Waste generated during construction would be adequately managed by the existing LANL waste management infrastructure.

LANL New Facility Alternative—The construction of new security Category I/II buildings at LANL's TA-55 would disturb approximately 1.8 hectares (4.5 acres) of land, but would not change the area's current land-use designation. At TA-55, the construction activities would not change the current land-use designation. The existing infrastructure would adequately support construction activities. Construction activities would result in temporary increases in air quality impacts, but would be below ambient air quality standards, except for short-term concentrations of total suspended particulates at TA-55. Construction activities would not significantly impact water, visual resources, biotic resources (including threatened and endangered species), geology and soils, or cultural and paleontological resources. The socioeconomic impacts associated with construction would not cause any major changes to employment, housing, or public finance in the socioeconomic region of influence. Waste generated during construction would be adequately managed by the existing LANL waste management infrastructure.

SNL/NM Alternative—The relocation of the TA-18 capabilities and materials associated with security Category I/II activities to SNL/NM would use 10 existing facilities, while also constructing a new, underground facility at TA-V. Approximately 1.8 hectares (4.5 acres) of land would be disturbed during construction of the new underground facility. The existing infrastructure would adequately support construction activities. Because the area was disturbed during previous construction activities at TA-V, further land disturbance is not expected to result in significant impacts on air, water, visual resources, biotic resources (including threatened and endangered species), geology and soils, or cultural and paleontological resources. The TA-18 operations would not change the area's current land-use designation. The socioeconomic impacts associated with construction would not cause any major changes to employment, housing, or public finance in the socioeconomic region of influence. Waste generated during construction would be adequately managed by the existing SNL/NM waste management infrastructure.

NTS Alternative—The relocation of the TA-18 capabilities and materials associated with security Category I/II activities to NTS would entail upgrading DAF and constructing a new low-scatter building adjacent to DAF, as well as a new administration building. Approximately 0.7 hectares (1.7 acres) of land would be disturbed. Because NTS is such a large, remote site, and because the area was disturbed previously during construction activities associated with DAF, further land disturbance would likely result in minor or no impacts to air, water, visual resources, biotic resources (including threatened and endangered species), geology and soils, or cultural and paleontological resources. The TA-18 operations would not change the area's current land-use designation. The socioeconomic impacts associated with construction would not cause any major changes to employment, housing, or public finance in the socioeconomic region of influence. Waste generated during construction would be adequately managed by the existing NTS waste management infrastructure.

ANL-W Alternative—The relocation of the TA-18 capabilities and materials associated with security Category I/II activities to ANL-W would entail the use of existing buildings and the construction of a new security Category experimental building, an addition to FMF, and a tunnel to the existing ZPPR building. Approximately 0.6 hectares (1.5 acres) of land would be disturbed during construction activities. The existing infrastructure would adequately support construction activities. Because the area was disturbed during previous construction activities, further land disturbance would likely result in no or minor impacts on air, water, visual resources, biotic resources (including threatened and endangered species), geology and soils, or cultural and paleontological resources. The TA-18 operations would not change the area's current land-use designation. The socioeconomic impacts associated with construction would not cause any major changes to employment, housing, or public finance in the socioeconomic region of influence. Waste generated during construction would be adequately managed by the existing ANL-W waste management infrastructure.

S.6.3 Operations Impacts

TA-18 capabilities and materials relocated to any of the alternative sites would use similar facilities, procedures, resources, and numbers of workers during operations. As such, similar infrastructure support would be needed, similar emissions and waste would be produced, and similar impacts on workers would occur. For each alternative, the proposed construction or modification of buildings, structures, and infrastructure is slightly different, as is the environmental setting. These site differences would lead to some differences in environmental impacts based on the same operations. For most environmental areas of concern, however, these differences would be minor. It is not expected that there would be any perceivable operations impact differences among the alternatives on air, water, visual resources, biotic resources (including threatened and endangered species), geology and soils, cultural and paleontological resources, power usage, socioeconomics, or worker risks. Additionally, all alternatives have adequate existing waste management facilities to treat, store, and/or dispose of waste that would be generated by these operations. For all alternative sites, all impacts would be within regulated limits and would comply with Federal, state, and local requirements.

Normal operations under all alternatives would reduce radiological impacts as compared to the existing TA-18 operations. There would be small differences in potential radiological impacts on the public among the site alternatives. However, for all site alternatives, public radiation exposure would be small and well below regulatory limits and limits imposed by DOE orders. For all sites, the maximally exposed offsite individual would receive less than 0.067 millirem per year from the normal operational activities at TA-18. Statistically, this translates into a risk that one additional fatal cancer would occur approximately every 29 million years due to these operations. Doses from SHEBA operations account for 90 percent of the calculated dose at LANL. The operational impacts at SNL/NM, NTS, and ANL-W would be significantly smaller because of lower radioactive releases and specifically remoteness of the latter two sites, leading to lower public radiation exposure. At all sites, the total dose to the population within 80 kilometers (50 miles) would be a maximum of 0.10 person-rem per year from normal operational activities at TA-18. Statistically, this would equate to one additional fatal cancer every 20,000 years. Again, doses from SHEBA operations account for 90 percent of the calculated dose at LANL. Further, due to the remoteness of NTS and ANL-W, and the fact that these sites have the smallest 50-mile-radius populations, the 50-mile-radius population dose would be the least at these sites.

Potential impacts from accidents were estimated using computer modeling. In the event of an accident involving the operational activities, the projected latent cancer fatalities at all relocation sites would be significantly less than 1. For the bounding accident analyzed in the EIS, the highest potential annual risk to the population within 80 kilometers (50 miles) from the TA-18 operations would be an increase in latent cancer fatalities of 5.1×10^{-5} from a potential hydrogen detonation accident at SHEBA. Statistically, this would equate to 1 additional latent cancer fatality among the affected population every 19,600 years of operation. Overall, the No Action Alternative, and specifically SHEBA operations, would produce the highest potential accident impact, primarily due to the fact that existing TA-18 facilities do not incorporate high-efficiency particulate air filtration, and, in the case of SHEBA, the design provides minimal containment.

S.6.4 Transportation Risks

Except for the No Action Alternative and the TA-18 Upgrade Alternative, all other site alternatives would require the transportation of equipment and materials. Such transportation would involve the relocation of approximately 2.4 metric tons (2.6 tons) of SNM, and approximately 10 metric tons (11 tons) of natural and depleted uranium and thorium, as well as support equipment, some of which would be radioactively contaminated. For all alternatives, the environmental impacts and potential risks of such transportation would be small. For all alternatives, the risks associated with radiological transportation would be less than one fatality per 10,000 years under normal and accident conditions. Although the potential risks would differ among the alternatives primarily as a function of the transportation distance, the impacts would be very small. Based on distance, the ANL-W Alternative would have the highest potential impact, the NTS Alternative the second-highest, the SNL/NM Alternative the third-highest, and the LANL New Facility Alternative the least risk (compared to the No Action and TA-18 Upgrade Alternatives).

S.6.5 Relocation of SHEBA and Other Security Category III/IV Activities

Relocation of SHEBA activities to TA-39 would entail the disturbance of approximately 0.08 hectares (0.2 acres) on a 1.6-hectare (4-acre) parcel of land for the construction of new buildings. Water main and utility lines would follow roadways to the new structures. Relocation of security Category III/IV activities to TA-55 would entail the disturbance of approximately 1.6 hectares (4 acres) on a 3.2-hectare (8-acre) parcel of land.

At either TA-39 or TA-55, the construction activities would not change the current land-use designation. The existing infrastructure would adequately support construction activities. Construction activities would result in temporary increases in air quality impacts, but would be below ambient air quality standards, except for short-term concentrations of total suspended particulates at TA-55. Construction activities would not significantly impact water, visual resources, biotic resources (including threatened and endangered species), geology and soils, or cultural and paleontological resources. The socioeconomic impacts associated with construction would not cause any major changes to the regional economic area employment, housing, or public finance. Waste generated during construction would be adequately managed by the existing LANL waste management infrastructure.

SHEBA operations at TA-39 would not have any significant impact on air, water, visual resources, biotic resources (including threatened and endangered species), geology and soils, cultural and paleontological resources, power usage, socioeconomics, or worker risks. All impacts would be within regulated limits and would comply with Federal, state, and local requirements. During SHEBA operations, approximately 100 curies of argon-41 per year would be released to the environment. This would result in a dose of 0.061 millirem to the maximally exposed member of the public, which is well below the limit of 10 millirem per year set by both the U.S. Environmental Protection Agency and DOE for airborne releases of radioactivity. For the bounding accident analyzed in the EIS, the highest potential annual risk to the population within 80 kilometers (50 miles) from the TA-18 operational activities would be an increase in latent cancer fatalities of 4.4×10^{-5} from a potential hydrogen detonation accident at SHEBA. Statistically, this would equate to 1 additional latent cancer fatality every 22,700 years of operation. The existing waste

Radiological Health Effects Risk Factors Used in the EIS

Health impacts of radiation exposure, whether from sources external or internal to the body, are generally identified as "somatic" (i.e., affecting the exposed individual) or "genetic" (i.e., affecting descendants of the exposed individual). Radiation is more likely to produce somatic effects (e.g., induced cancers) than genetic effects. 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. Because of the delayed effect, the cancers are referred to as "latent" cancers.

For a uniform irradiation of the body, the incidence of cancer varies among organs and tissues; the thyroid gland and skin demonstrate a greater sensitivity than other organs. Such cancers, however, also produce comparatively low mortality rates because they are relatively amenable to medical treatment. Because fatal cancer is the most probable serious effect of environmental and occupational radiation exposure, estimates of cancer fatalities, rather than cancer incidents, are presented in the EIS.

The number of latent cancer fatalities is estimated using risk factors determined by the International Commission on Radiological Protection. A risk factor is the probability that an individual would incur a latent cancer fatality during his or her lifetime if the individual receives a unit of radiation dose (1 rem). The risk factor for workers is 0.0004 (latent cancer fatalities per rem), and 0.0005 (latent cancer fatalities per rem) for individuals among the general public. The risk factor for the public is slightly higher because the public includes infants and children, who are more sensitive to radiation than adults.

Examples:

> The latent cancer fatality risk for an individual (nonworker) receiving a dose of 0.1 rem would be 0.00005 (0.1 rem x 0.0005 latent cancer fatalities per rem). This risk can also be expressed as "0.005 percent chance" or "1 chance in 20,000."
>
> The same concept is used to calculate the latent cancer fatality risk from exposing a group of individuals to radiation. The latent cancer fatality risk for individuals in a group of 100,000, each receiving a dose of 0.1 rem, would be 0.00005, as indicated above. This individual risk, multiplied by the number of individuals in the group, expresses the number of latent cancer fatalities that could occur among the individuals in the group. In this example, the number would be 5 latent cancer fatalities (100,000 x 0.00005). A number of latent cancer fatalities less than 1 means that the radiation exposure is not sufficient to cause a single latent cancer fatality among the members of the group. In this case, the risk is expressed as a probability that a single latent cancer fatality would occur among the members of the group. For example, 0.05 latent cancer fatalities can be stated as "there is 1 chance in 20 (1/0.05) that 1 latent cancer fatality would occur among the members of the group."

The EIS provides estimates of probability of a latent cancer fatality occurring for the involved and noninvolved workers, the maximally exposed offsite individual, an average individual, and the general population. These categories are defined as follows:

Involved worker—An individual worker participating in the operation of the facilities

Noninvolved worker—An individual worker at the site other than the involved worker

Maximally exposed offsite individual—A hypothetical member of the public residing at the site boundary who could receive the maximum dose of radiation or exposure to hazardous chemicals

Average individual—A member of the public receiving an average dose of radiation or exposure to hazardous chemicals

Population—Members of the public residing within an 80-kilometer (50-mile) radius of the facility.

management facilities at LANL would be adequate to treat, store, and/or dispose of waste that would be generated by this mission.

S.6.6 Impacts Common to All Alternatives

Critical Assembly Machine Refurbishment. One impact that would be common to all alternatives under the proposed action is the one-time generation of approximately 1.5 cubic meters (2 cubic yards) of low-level and mixed low-level radioactive waste from the refurbishment of the criticality machines currently housed at TA-18. The radioactive waste would consist of old electrical racks, hydraulic systems, control cartridges, and machine stands that would be replaced by new components as part of TA-18 mission relocation activities. The refurbishment of these criticality machines would occur under any of the proposed alternatives. Disposition of the radioactive and nonradioactive waste would be in accordance with established procedures. The impact of managing this waste would be minimal given the available site capacity at LANL.

Decontamination and Decommissioning. All alternatives would require some level of decontamination and decommissioning. Operations experience with TA-18 critical assembly machines has shown that, although some surface contamination may result from the conduct of specific criticality experiments, the nature and magnitude of this contamination is such that it can be easily removed and reduced to acceptable levels. Consequently, impacts associated with decontamination and decommissioning are expected to be limited to waste created that is within LANL's and other alternative sites' waste management capabilities. This, therefore, would not be a discriminating factor among the alternatives.

Decontamination and decommissioning at TA-18 would also involve environmental restoration activities to reduce the long-term public and worker health and safety risks associated with potentially contaminated areas within the site or with surplus facilities and to reduce the risk posed to ecosystems. Decisions regarding whether and how to undertake environmental restoration action would be made after a detailed assessment of the short- and long-term risks and benefits within the framework of the Resource Conservation and Recovery Act (RCRA). The approach for controlling the consequences of environmental restoration activities at LANL is summarized in the *LANL SWEIS*. Decontamination and decommissioning of TA-18 would involve the general types of activities described and analyzed in the *LANL SWEIS* (e.g., generation of low-level radioactive waste). Specific alternatives to be considered in the decontamination and decommissioning process would likely follow the RCRA framework and will be subject to project-specific NEPA analysis.

Table S–3 Summary of Environmental Consequences for the Relocation of TA-18 Operations

Resource/Material Categories	*No Action Alternative*		*TA-18 Upgrade Alternative*		*LANL New Facility Alternative*		*SNL/NM Alternative*	
Land Resource								
- Construction/Operations	No impact		0.5 acres/no impact		4.5 acres/no impact		4.5 acres/no impact	
Air Quality								
- Construction	No impact		Small temporary impact		Small temporary impact		Small temporary impact	
- Operations	110 curies per year of argon-41 released		110 curies per year of argon-41 released		10 curies per year of argon-41 released		10 curies per year of argon-41 released	
Water Resource								
- Construction	No impact		Small temporary impact		Small temporary impact		Small temporary impact	
- Operations	Small impact		Small impact		Small impact		Small impact	
Socioeconomics								
- Construction	No noticeable changes; No impact		No noticeable changes; 100 workers (peak); 422 jobs		No noticeable changes; 300 workers (peak); 1,152 jobs		No noticeable changes; 300 workers (peak)	
- Operations	No increase in workforce		No increase in workforce		No increase in workforce		20 people relocated or new hires	
Public and Occupational Health and Safety								
Normal Operations	***Dose***	***LCF***	***Dose***	***LCF***	***Dose***	***LCF***	***Dose***	***LCF***
- Population dose (person-rem per year)	0.10	0.00005	0.10	0.00005	0.011	5.5×10^{-6}	0.020	0.00001
- MEI (millirem per year)	0.067	3.4×10^{-8}	0.067	3.4×10^{-8}	0.0025	1.3×10^{-9}	0.00032	1.6×10^{-10}
- Average individual dose (millirem per year)	0.00030	1.5×10^{-10}	0.00030	1.5×10^{-10}	0.00004	2×10^{-11}	0.000027	1.3×10^{-11}
- Total worker dose (person-rem per year)	21	0.0085	21	0.0085	10 [b]	0.0040	10 [b]	0.0040
- Average worker dose (millirem per year)	100	0.00004	100	0.00004	100	0.00004	100	0.00004
- Hazardous chemicals	None		None		None		None	
Accidents (Maximum Annual Cancer Risk, LCF)								
- Population	5.1×10^{-5}		5.1×10^{-5}		9.1×10^{-8}		2.2×10^{-7}	
- MEI	1.7×10^{-7}		1.7×10^{-7}		6.1×10^{-11}		1.7×10^{-11}	
- Noninvolved worker	2.0×10^{-6}		2.0×10^{-6}		2.8×10^{-9}		2.8×10^{-9}	
Chemical Accidents	None							
Environmental Justice	No disproportionally high and adverse impacts on minority or low-income populations							
Waste Management (cubic meters of solid waste per year): Waste would be disposed of properly with small impact								
- Low-level radioactive waste [d]	145		145		145		145	
- Mixed low-level radioactive waste [d]	1.5		1.5		1.5		1.5	
- Hazardous waste	4		4		4		4	
Transportation								
- Incident-free	***Person-rem***	***LCF***	***Person-rem***	***LCF***	***Person-rem***	***LCF***	***Person-rem***	***LCF***
- Population	(f)	(f)	(f)	(f)	(f)	(f)	0.040	0.000020
- Workers	(f)	(f)	(f)	(f)	(f)	(f)	0.025	0.000010
Accidents								
- Population	(f)	(f)	(f)	(f)	(f)	(f)	7.0×10^{-6}	3.5×10^{-9}

LCF = latent cancer fatality; MEI = maximally exposed individual.

[a] Impacts to be considered in conjunction with the relocation of security Category I/II capabilities and materials if the security Category III/IV activities do not remain at TA-18.

[b] There would be an additional one-time dose to the workers of 2.3 person-rem from handling activities of the SNM that would be transported from TA-18 to the alternative site.

[c] There would be an additional one-time dose to workers of 0.02 person-rem from handling activities of materials associated with SHEBA operations.

NTS Alternative		ANL-W Alternative		SHEBA Relocation to TA-39 [a]		Other Security Category III/IV Relocation to TA-55 [a]	
1.7 acres/no impact		1.5 acres/no impact		0.2 acres/no impact		4.1 acres/no impact	
Small temporary impact		Small temporary impact		Small temporary impact		Small temporary impact	
10 curies per year of argon-41 released		10 curies per year of argon-41 released		100 curies per year of argon-41 released		Trace level of radioactivity released	
Small temporary impact		Small temporary impact		Small temporary impact		Small temporary impact	
Small impact		Small impact		Small impact		Small impact	
No noticeable changes; 60 workers (peak)		No noticeable changes; 120 workers (peak)		No noticeable changes; 25 workers (peak)		No noticeable changes; 45 workers (peak)	
20 people relocated or new hires		20 people relocated or new hires		No increase in workforce		No increase in workforce	
Dose	***LCF***	***Dose***	***LCF***	***Dose***	***LCF***	***Dose***	***LCF***
0.000070	3.5×10^{-8}	0.00041	2.1×10^{-7}	0.087	0.000044	Small	
0.000087	4.4×10^{-11}	0.00021	1.1×10^{-10}	0.061	3.0×10^{-8}	Small	
3.9×10^{-6}	1.9×10^{-12}	1.7×10^{-6}	8.6×10^{-13}	0.00019	1.0×10^{-10}	Small	
10 [b]	0.0040	10 [b]	0.0040	11 [c]	0.0045	Small	
100	0.00004	100	0.00004	100	0.00004	Small	
None		None		None		None	
7.7×10^{-10}		7.7×10^{-9}		4.9×10^{-5}		Small	
2.5×10^{-12}		7.3×10^{-12}		1.4×10^{-7}		Small	
4.0×10^{-9}		7.2×10^{-9}		2.0×10^{-6}		Small	
None							
No disproportionally high and adverse impacts on minority or low-income populations							
145		145		(e)		(e)	
1.5		1.5		(e)		(e)	
4		4		(e)		(e)	
Person-rem	***LCF***	***Person-rem***	***LCF***	***Person-rem***	***LCF***	***Person-rem***	***LCF***
0.33	0.00016	0.39	0.00019	(f)	(f)	(f)	(f)
0.25	0.00010	0.28	0.00011	(f)	(f)	(f)	(f)
0.000028	1.4×10^{-8}	0.000038	1.9×10^{-8}	(f)	(f)	(f)	(f)

[d] There would be a one-time generation of 1.5 cubic meters of low-level radioactive and mixed low-level radioactive waste at LANL from the refurbishment of the critical assembly machines.

[e] Waste generation from SHEBA, security Category III/IV, and security Category I/II activities would be similar to those generated under the No Action Alternative.

[f] LANL intrasite SNM and material transportation impacts would be bounded by the normal operation and accident impacts evaluated for the various LANL alternatives.

S.7 GLOSSARY

***actinide* —** Any member of the group of elements with atomic numbers from 89 (actinium) to 103 (lawrencium) including uranium and plutonium. All members of this group are radioactive.

***activation products* —** Nuclei, usually radioactive, formed by bombardment and absorption in material with neutrons, protons, or other nuclear particles.

***ambient air quality standards* —** The level of pollutants in the air prescribed by regulations that may not be exceeded during a specified time in a defined area. Air quality standards are used to provide a measure of the health-related and visual characteristics of the air.

***aquatic* —** Living or growing in, on, or near water.

***argon-41* —** A radioactive argon isotope with a half-life of 1.83 hours that emits beta particles and gamma radiation. It is formed by the activation, by neutron absorption, of argon-40, a stable argon isotope present in small quantities in air.

***baseline* —** The existing environmental conditions against which impacts of the proposed action and its alternatives can be compared. For this EIS, the environmental baseline is the site environmental conditions as they exist or are estimated to exist in the absence of the proposed action.

***becquerel* —** A unit of radioactivity equal to one disintegration per second. Thirty-seven billion becquerels equal 1 curie.

***beyond-design-basis events* —** Postulated disturbances in process variables due to external events or multiple component or system failures that can potentially lead to beyond-design-basis accidents.

***biota (biotic)* —** The plant and animal life of a region (pertaining to biota).

***bounded* —** Producing the greatest consequences of any assessment of impacts associated with normal or abnormal operations.

***cancer* —** The name given to a group of diseases characterized by uncontrolled cellular growth, with cells having invasive characteristics such that the disease can transfer from one organ to another.

***carcinogen* —** An agent that may cause cancer. Ionizing radiations are physical carcinogens; there are also chemical and biological carcinogens and biological carcinogens may be external (e.g., viruses) or internal (genetic defects).

***CASA (Critical Assembly Storage Area)* —** In this *TA-18 Relocation EIS*, one of the remote-controlled critical assembly buildings associated with the Los Alamos Critical Experiments Facility.

***cell* —** See *hot cell*.

***Comet* —** A general-purpose critical assembly machine designed to accommodate a wide variety of experiments in which neutron multiplication must be measured as a function of distance between components. Currently located at the TA-18 facilities, subject to relocation.

***community (biotic)* —** All plants and animals occupying a specific area under relatively similar conditions.

***community (environmental justice)* —** A group of people or a site within a spatial scope exposed to risks that potentially threaten health, ecology, or land values or are exposed to industry that stimulates unwanted noise, smell, industrial traffic, particulate matter, or other nonaesthetic impacts.

***contamination* —** The deposition of undesirable radioactive material on the surfaces of structures, areas, objects, or personnel.

***critical assembly* —** A critical assembly is a system of fissile material (uranium-233, uranium-235, plutonium-239, or plutonium-241) with or without a moderator in a specific proportion and shape. The critical assembly can be gradually built up by adding additional fissile material and/or moderator until this system achieves the dimensions necessary for a criticality condition. A continuous neutron source is placed at the center of this assembly to measure the fission rate of the critical assembly as it approaches and reaches criticality.

***critical mass* —** The smallest mass of fissionable material that will support a self-sustaining nuclear fission chain reaction.

***criticality* —** The condition in which a system is capable of sustaining a nuclear fission chain reaction.

***cumulative impacts* —** The impacts on the environment that result from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions, regardless of the agency or person who undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

***decontamination* —** The actions taken to reduce or remove substances that pose a substantial present or potential hazard to human health or the environment, such as radioactive or chemical contamination from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

***defense-in-depth* —** The use of multiple, independent protection elements combined in a layered manner so that the system capabilities do not depend on a single component to maintain effective protection against defined threats.

***delayed critical devices* —** A critical assembly designed to reach the condition of delayed supercriticality. Delayed criticality is the nuclear physics supercriticality condition, where the neutron multiplication factor of the assembly is between 1 (critical) and 1 plus the delayed neutron fraction. (See *multiplication factor* and *delayed neutrons*.)

***delayed neutrons* —** Neutrons emitted from fission products by beta decay following fission by intervals of seconds to minutes. Delayed neutrons account for approximately 0.2 to 0.7 percent of all fission neutrons. For uranium-235, the delayed neutron fraction is about 0.007; for plutonium-239, it is about 0.002.

***depleted uranium* —** Uranium whose content of the fissile isotope uranium-235 is less than the 0.7 percent (by weight) found in natural uranium, so that it contains more uranium-238 than natural uranium.

***design basis* —** For nuclear facilities, information that identifies the specific functions to be performed by a structure, system, or component, and the specific values (or ranges of values) chosen for controlling parameters for reference bounds for design. These values may be: (1) restraints derived from generally accepted state-of-the-art practices for achieving functional goals; (2) requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which a structure, system, or component must meet its functional goals; or (3) requirements derived from Federal safety objectives, principles, goals, or requirements.

***dose* —** A generic term that means absorbed dose, effective dose equivalent, committed effective dose equivalent, or total effective dose equivalent, as defined elsewhere in this glossary. It is a measure of the energy imparted to matter by ionizing radiation. The unit of dose is the rem or rad.

***effluent* —** A gas or fluid discharged into the environment.

***endangered species* —** Defined in the Endangered Species Act of 1973 as "any species which is in danger of extinction throughout all or a significant portion of its range."

***enriched uranium* —** Uranium whose content of the fissile isotope uranium-235 is greater than the 0.7 percent (by weight) found in natural uranium. (See *uranium, natural uranium*, and *highly enriched uranium*.)

***environmental impact statement (EIS)* —** The detailed written statement required by Section 102(2)(C) of the National Environmental Policy Act for a proposed major Federal action significantly affecting the quality of the human environment. A DOE EIS is prepared in accordance with applicable requirements of the Council on Environmental Quality National Environmental Policy Act regulations in 40 CFR 1500–1508 and the DOE National Environmental Policy Act regulations in 10 CFR 1021. The statement includes, among other information, discussions of the environmental impacts of the proposed action and all reasonable alternatives; adverse environmental effects that cannot be avoided should the proposal be implemented; the relationship between short-term uses of the human environment and enhancement of long-term productivity; and any irreversible and irretrievable commitments of resources.

***environmental justice* —** The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, local, and tribal programs and policies. Executive Order 12898 directs Federal agencies to make achieving environmental justice part of their missions by identifying and addressing disproportionately high and adverse effects of agency programs, policies, and activities on minority and low-income populations.

***fissile materials* —** An isotope that readily fissions after absorbing a neutron of any energy. Fissile materials are uranium-233, uranium-235, plutonium-239, and plutonium-241. Uranium-235 is the only naturally occurring fissile isotope.

***fission* —** The splitting of the nucleus of a heavy atom into two lighter nuclei. It is accompanied by the release of neutrons, gamma rays, and kinetic energy of fission products.

***fission products* —** Nuclei (fission fragments) formed by the fission of heavy elements, plus the nuclides formed by the fission fragments' radioactive decay.

***Flattop* —** A critical assembly machine designed to provide benchmark neutronic measurements in a spherical geometry with a number of different fissile driver materials. Currently located at the TA-18 facilities, subject to relocation.

floodplain — The lowlands and relatively flat areas adjoining inland and coastal waters and the flood-prone areas of offshore islands. Floodplains include, at a minimum, that area with at least a 1.0 percent chance of being inundated by a flood in any given year.

The *base floodplain* is defined as the area which has a 1.0 percent or greater chance of being flooded in any given year. Such a flood is known as a 100-year flood.

The *critical action floodplain* is defined as the area which has at least a 0.2 percent chance of being flooded in any given year. Such a flood is known as a 500-year flood. Any activity for which even a slight chance of flooding would be too great (e.g., the storage of highly volatile, toxic, or water-reactive materials) should not occur in the critical action floodplain.

The *probable maximum flood* is the hypothetical flood considered to be the most severe reasonably possible flood, based on the comprehensive hydrometeorological application of maximum precipitation and other hydrological factors favorable for maximum flood runoff (e.g., sequential storms and snowmelts). It is usually several times larger than the maximum recorded flood.

genetic effects — Inheritable changes (chiefly mutations) produced by exposure of the parts of cells that control biological reproduction and inheritance to ionizing radiation or other chemical or physical agents.

geology — The science that deals with the Earth: the materials, processes, environments, and history of the planet, including rocks and their formation and structure.

Godiva — A fast-burst critical assembly machine currently located at the TA-18 facilities, subject to relocation.

groundwater — Water below the ground surface in a zone of saturation.

half-life — The time in which one-half of the atoms of a particular radioactive isotope disintegrate to another nuclear form. Half-lives vary from millionths of a second to billions of years.

hazardous chemical — Under 29 CFR 1910, Subpart Z, hazardous chemicals are defined as "any chemical which is a physical hazard or a health hazard." Physical hazards include combustible liquids, compressed gases, explosives, flammables, organic peroxides, oxidizers, pyrophorics, and reactives. A health hazard is any chemical for which there is good evidence that acute or chronic health effects occur in exposed employees. Hazardous chemicals include carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, agents that act on the hematopoietic system, and agents that damage the lungs, skin, eyes, or mucous membranes.

hazardous material — A material, including a hazardous substance, as defined by 49 CFR 171.8, which poses a risk to health, safety, and property when transported or handled.

hazardous waste — A category of waste regulated under the Resource Conservation and Recovery Act. To be considered hazardous, a waste must be a solid waste under the Resource Conservation and Recovery Act and must exhibit at least one of four characteristics described in 40 CFR 261.20 through 40 CFR 261.24 (i.e., ignitability, corrosivity, reactivity, or toxicity) or be specifically listed by the U.S. Environmental Protection Agency in 40 CFR 261.31 through 40 CFR 261.33.

high-level radioactive waste — High-level waste is the highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations, and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation.

***high-multiplication devices* —** A critical assembly for producing nondestructive superprompt critical nuclear excursions. These types of devices are sometimes called prompt burst devices. (See *prompt critical device* and *nuclear excursion*.)

***highly enriched uranium* —** Uranium whose content of the fissile isotope uranium-235 has been increased through enrichment to 20 percent or more (by weight). (See *natural uranium, enriched uranium*, and *depleted uranium*.)

***historic resources* —** Physical remains that postdate the emergence of written records; in the United States, they are architectural structures or districts, archaeological objects, and archaeological features dating from 1492 and later.

***hot cell* —** A shielded facility that requires the use of remote manipulators for handling radioactive materials.

***isotope* —** An atom of a chemical element with a specific atomic number and atomic mass. Isotopes of the same element have the same number of protons but different numbers of neutrons and different atomic masses.

***latent cancer fatalities* —** Deaths from cancer occurring some time after, and postulated to be due to, exposure to ionizing radiation or other carcinogens.

***low-level radioactive waste* —** Waste that contains radioactivity but is not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined by Section 11e (2) of the Atomic Energy Act of 1954, as amended. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level radioactive waste, provided the concentration of transuranic waste is less than 100 nanocuries per gram.

***Magnitude* —** A number that reflects the relative strength or size of an earthquake. Magnitude is based on the logarithmic measurement of the maximum motion recorded by a seismograph. An increase of one unit of magnitude (for example, from 4.6 to 5.6) represents a 10-fold increase in wave amplitude on a seismograph recording or approximately a 30-fold increase in the energy released. Several scales have been defined, but the most commonly used are (1) local magnitude (ML), commonly referred to as "Richter magnitude," (2) surface-wave magnitude (Ms), (3) body-wave magnitude (Mb), and (4) moment magnitude (Mw). Each is valid for a particular type of seismic signal varying by such factors as frequency and distance. These magnitude scales will yield approximately the same value for any given earthquake within each scale's respective range of validity.

***maximally exposed individual* —** A hypothetical individual receiving radiation doses from transporting radioactive materials on the road. For the incident-free transport operation, the maximally exposed individual would be an individual stuck in traffic next to the shipment for 30 minutes. For accident conditions, the maximally exposed individual is assumed to be an individual located approximately 33 meters (100 feet) directly downwind from the accident.

***maximally exposed offsite individual* —** A hypothetical individual whose location and habits result in the highest total radiological or chemical exposure (and thus dose) from a particular source for all exposure routes (e.g., inhalation, ingestion, direct exposure).

mixed waste — Waste that contains both nonradioactive hazardous waste and radioactive waste, as defined in this glossary.

multiplication factor (k_{eff}) — For a chain-reacting system, the mean number of fission neurons produced by a neutron during its life within the system. For the critical system, the multiplication factor is equal to 1. If the multiplication factor is less than 1, the system is called "subcritical." Conversely, if the multiplication factor is greater than 1, the system is called "supercritical."

natural uranium — Uranium with the naturally occurring distribution of uranium isotopes (approximately 0.7-weight percent uranium-235 with the remainder essentially uranium-238). (See *uranium*, *depleted uranium*, *enriched uranium*, *highly enriched uranium*, and *low-enriched uranium*.)

neutron — An uncharged elementary particle with a mass slightly greater than that of the proton. Neutrons are found in the nucleus of every atom heavier than hydrogen-1.

nitrogen — A natural element with the atomic number 7. It is diatomic in nature and is a colorless and odorless gas that constitutes about four-fifths of the volume of the atmosphere.

normal operations — All normal (incident-free) conditions and those abnormal conditions that frequency estimation techniques indicate occur with a frequency greater than 0.1 events per year.

Notice of Intent — Announces the scoping process. The Notice of Intent is usually published in the *Federal Register* and a local newspaper. The scoping process includes holding at least one public meeting and requesting written comments on issues and environmental concerns that an EIS should address.

nuclear criticality — See *criticality*.

nuclear excursion — A very short time period (in milliseconds) during which the fission rate of a supercritical system increases, peaks, and then decreases to a low value.

nuclear explosive — Any assembly containing fissionable and/or fusionable materials and main-charge high-explosive parts or propellants capable of producing a nuclear detonation.

nuclear facility — A facility subject to requirements intended to control potential nuclear hazards. Defined in DOE directives as any nuclear reactor or any other facility whose operations involve radioactive materials in such form and quantity that a significant nuclear hazard potentially exists to the employees or the general public.

nuclear material — Composite term applied to: (1) special nuclear material; (2) source material such as uranium, thorium, or ores containing uranium or thorium; and (3) byproduct material, which is any radioactive material that is made radioactive by exposure to the radiation incident or to the process of producing or using special nuclear material.

off site — The term denotes a location, facility, or activity occurring outside of the site boundary.

on site — The term denotes a location or activity occurring somewhere within the boundary of the DOE Complex site.

package — For radioactive materials, the packaging, together with its radioactive contents, as presented for transport (the packaging plus the radioactive contents equals the package).

paleontological resources — The physical remains, impressions, or traces of plants or animals from a former geologic age; may be sources of information on ancient environments and the evolutionary development of plants and animals.

person-rem — The unit of collective radiation dose commitment to a given population; the sum of the individual doses received by a population segment.

PIDAS (Perimeter Intrusion Detection and Assessment System) — A mutually supporting combination of barriers, clear zones, lighting, and electronic intrusion detection, assessment, and access control systems constituting the perimeter of the Protected Area and designed to detect, impede, control, or deny access to the Protected Area.

Planet — A general-purpose critical assembly machine designed to accommodate a wide variety of neutron multiplication experiments. Currently located at the TA-18 facilities, subject to relocation.

plutonium — A heavy, radioactive, metallic element with the atomic number 94. It is produced artificially by neutron bombardment of uranium. Plutonium has 15 isotopes with atomic masses ranging from 232 to 246 and half-lives from 20 minutes to 76 million years.

plutonium-239 — An isotope of plutonium with a half-life of 24,110 years which is the primary radionuclide in weapons-grade plutonium. When plutonium-239 decays, it emits alpha particles.

prehistoric resources — The physical remains of human activities that predate written records; they generally consist of artifacts that may alone or collectively yield otherwise inaccessible information about the past.

process — Any method or technique designed to change the physical or chemical character of the product.

prompt critical device — A critical assembly designed to reach the condition of prompt criticality. Prompt criticality is the nuclear physics supercriticality condition, due to neutrons released immediately during the fission process, in which a mass and geometric configuration of fissile material (uranium-233, uranium-235, plutonium-239, or plutonium-241) results in an extremely rapid increase in the number of fissions from one neutron generation to the next. Prompt criticality does not rely on the releases of delayed neutrons, which are not released immediately, but rather over a period of about one minute after fission.

Prompt criticality describes the condition in which the nuclear fission reaction is not only self-sustaining, but also increasing at a very rapid rate.

Protected Area — A type of security area defined by physical barriers (i.e., walls or fences), to which access is controlled, used for protection of security Category II special nuclear materials and classified matter and/or to provide a concentric security zone surrounding a Material Access Area (security Category I nuclear materials) or a Vital Area.

radioactive waste — In general, waste that is managed for its radioactive content. Waste material that contains source, special nuclear, or byproduct material is subject to regulation as radioactive waste under the Atomic Energy Act. Also, waste material that contains accelerator-produced radioactive material or a high concentration of naturally occurring radioactive material may be considered radioactive waste.

radioactivity —

Defined as a process: The spontaneous transformation of unstable atomic nuclei, usually accompanied by the emission of ionizing radiation.

Defined as a property: The property of unstable nuclei in certain atoms to spontaneously emit ionizing radiation during nuclear transformations.

radioisotope or radionuclide — An unstable isotope that undergoes spontaneous transformation, emitting radiation. (See *isotopes*.)

radon — A gaseous, radioactive element with the atomic number 86, resulting from the radioactive decay of radium. Radon occurs naturally in the environment and can collect in unventilated enclosed areas, such as basements. Large concentrations of radon can cause lung cancer in humans.

Record of Decision — A document prepared in accordance with the requirements of 40 CFR 1505.2 and 10 CFR 1021.315 that provides a concise public record of DOE's decision on a proposed action for which an EIS was prepared. A Record of Decision identifies the alternatives considered in reaching the decision; the environmentally preferable alternative; factors balanced by DOE in making the decision; and whether all practicable means to avoid or minimize environmental harm have been adopted, and, if not, the reasons they were not.

region of influence — A site-specific geographic area in which the principal direct and indirect effects of actions are likely to occur and are expected to be of consequence for local jurisdictions.

rem (roentgen equivalent man) — A unit of dose equivalent. The dose equivalent in rem equals the absorbed dose in rad in tissue multiplied by the appropriate quality factor and possibly other modifying factors. Derived from "roentgen equivalent man," referring to the dosage of ionizing radiation that will cause the same biological effect as 1 roentgen of x-ray or gamma-ray exposure. One rem equals 0.01 sievert.

risk — The probability of a detrimental effect from exposure to a hazard. Risk is often expressed quantitatively as the probability of an adverse event occurring multiplied by the consequence of that event (i.e., the product of these two factors).

safeguards — An integrated system of physical protection, material accounting, and material control measures designed to deter, prevent, detect, and respond to unauthorized access, possession, use, or sabotage of nuclear materials.

sanitary waste — Waste generated by normal housekeeping activities, liquid or solid (includes sludge), which are not hazardous or radioactive.

scope — In a document prepared pursuant to the National Environmental Policy Act of 1969, the range of actions, alternatives, and impacts to be considered.

scoping — An early and open process for determining the scope of issues to be addressed in an EIS and for identifying the significant issues related to a proposed action. The scoping period begins after publication in the *Federal Register* of a Notice of Intent to prepare an EIS. The public scoping process is that portion of the process where the public is invited to participate. DOE also conducts an early internal scoping process for environmental assessments or EISs. For EISs, this internal scoping process precedes the public scoping process. DOE's scoping procedures are found in 10 CFR 1021.311.

***security* —** An integrated system of activities, systems, programs, facilities, and policies for the protection of restricted data and other classified information or matter, nuclear materials, nuclear weapons and nuclear weapons components, and/or DOE contractor facilities, property, and equipment.

***sewage* —** The total organic waste and wastewater generated by an industrial establishment or a community.

***SHEBA (Solution High-Energy Burst Assembly)* —** A low-enriched uranium solution criticality machine designed to provide the capability for free-field irradiations of criticality alarm systems and the validation of dosimetry. Currently located at the TA-18 facilities, subject to relocation.

***shielding* —** In regard to radiation, any material of obstruction (bulkheads, walls, or other construction) that absorbs radiation to protect personnel or equipment.

***soils* —** All unconsolidated materials above bedrock. Natural earthy materials on the earth's surface, in places modified or even made by human activity, containing living matter, and supporting or capable of supporting plants out of doors.

***staging* —** The process of using several layers to achieve a combined effect greater than that of one layer.

***stockpile* —** The inventory of active nuclear weapons for the strategic defense of the United States.

***surface water* —** All bodies of water on the surface of the earth and open to the atmosphere, such as rivers, lakes, reservoirs, ponds, seas, and estuaries.

***transuranic waste* —** Radioactive waste not classified as high-level radioactive waste and that contains more than 100 nanocuries (3,700 becquerels) per gram of alpha-emitting transuranic isotopes with half-lives greater than 20 years.

***uranium* —** A radioactive, metallic element with the atomic number 92; one of the heaviest naturally occurring elements. Uranium has 14 known isotopes, of which uranium-238 is the most abundant in nature. Uranium-235 is commonly used as a fuel for nuclear fission. (See *natural uranium*, *enriched uranium*, *highly enriched uranium*, and *depleted uranium*.)

***vault (special nuclear material)* —** A penetration-resistant, windowless enclosure having an intrusion alarm system activated by opening the door and which also has: (1) walls, floor, and ceiling substantially constructed of materials which afford forced-penetration resistance at least equivalent to that of 8-inch-thick reinforced concrete; (2) a built-in combination-locked steel door which, for existing structures, is at least 1 inch thick exclusive of bolt work and locking devices and which, for new structures, meets standards set forth in Federal specifications and standards.

***waste management* —** The planning, coordination, and direction of those functions related to the generation, handling, treatment, storage, transportation, and disposal of waste, as well as associated surveillance and maintenance activities.

DOE/EIS-319D
August 2001

Draft Environmental Impact Statement for the

Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory

VOLUME 1

Chapters 1 through 11

United States Department of Energy
National Nuclear Security Administration
Washington, DC 20585

COVER SHEET

Responsible Agency: United States Department of Energy (DOE)

Title: Draft Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory (TA-18 Relocation EIS)

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***Abstract*:** The National Nuclear Security Administration, a separately organized agency within DOE, is responsible for providing the Nation with nuclear weapons, ensuring the safety and reliability of those nuclear weapons, and supporting programs that reduce global nuclear proliferation. These missions are accomplished through the use of DOE's core team of highly trained nuclear experts. One of the major training facilities for DOE personnel is located at Technical Area 18 (TA-18), within the Los Alamos National Laboratory (LANL), Los Alamos, New Mexico. Principal TA-18 operational activities involve research in and the design, development, construction, and application of experiments on nuclear criticality.

Though TA-18 is judged to be secure by DOE's independent inspection office, its buildings and infrastructure are from 30 to more than 50 years old and are increasingly expensive to maintain and operate. Additionally, the TA-18 operations are located in a relatively isolated area, resulting in increasingly high costs to maintain a security Category I infrastructure. DOE wishes to maintain the important capabilities currently provided at TA-18 in a manner that reduces the long-term costs for safeguards and security. DOE proposes to accomplish this by relocating the TA-18 security Category I/II capabilities and materials to new locations.

The *TA-18 Relocation EIS* evaluates the potential direct, indirect, and cumulative environmental impacts associated with this proposed action at the following DOE sites: (1) a different site at LANL (the Preferred Alternative) at Los Alamos, New Mexico; (2) the Sandia National Laboratories/New Mexico at Albuquerque, New Mexico; (3) the Nevada Test Site near Las Vegas, Nevada; and (4) the Argonne National Laboratory-West near Idaho Falls, Idaho. The EIS also analyzes upgrading of the TA-18 facilities at LANL. As required by Council on Environmental Quality regulations, the *TA-18 Relocation EIS* also evaluates the No Action Alternative of maintaining the operations at the current TA-18 location.

Public Comments: In preparing this draft EIS, DOE considered comments received from the public during the scoping period (May 2, 2000, through June 15, 2000). Comments on this draft EIS may be submitted during the 45-day comment period. Public meetings on this EIS will be held during the comment period. The dates, times, and locations of these meetings will be published in the *Federal Register* notice announcing the availability of this draft EIS.

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Acronyms, Abbreviations, and Conversion Charts

TA-18

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ANL-W	Argonne National Laboratory-West
BEIR	Biological Effects of Ionizing Radiation
CASA	Critical Assembly Storage Area
CAV	critical assembly vessel
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
DAF	Device Assembly Facility
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
EA	environmental analysis
EBR-II	Experimental Breeder Reactor-II
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FFTF	Fast Flux Test Facility
FMF	Fuel Manufacturing Facility
FR	*Federal Register*
FY	fiscal year
GPEB	general-purpose experimental building
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
KAFB	Kirtland Air Force Base
LACEF	Los Alamos Critical Experiments Facility
LANL	Los Alamos National Laboratory
MESA	Microsystems and Engineering Sciences Applications
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NMAC	New Mexico Administrative Code
NMSF	Nuclear Material Storage Facility
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NTS	Nevada Test Site
OSHA	Occupational Safety and Health Administration
PEIS	programmatic environmental impact statement
PIDAS	Perimeter Intrusion Detection and Assessment System
PM_n	particulate matter less than or equal to *n* microns in aerodynamic diameter
RCRA	Resource Conservation and Recovery Act
SARP	Safety Analysis Report for Packaging
SEA	special environmental analysis
SHEBA	Solution High-Energy Burst Assembly
SNL/NM	Sandia National Laboratories/New Mexico
SNM	special nuclear material(s)
START	Strategic Arms Reduction Treaty

SWEIS	sitewide environmental impact statement
TA	technical area
TA-18	Technical Area 18
TREAT	Transient Reactor Test Facility
USFWS	United States Fish and Wildlife Service
U.S.C.	*United States Code*
ZPPR	Zero Power Physics Reactor

Metric Conversion Chart

To Convert Into Metric			*To Convert From Metric*		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092903	square meters	square meters	10.7639	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.40469	hectares	hectares	2.471	acres
square miles	2.58999	square kilometers	square kilometers	0.3861	square miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32, then multiply by 0.55556	Celsius	Celsius	Multiply by 1.8, then add 32	Fahrenheit

Metric Prefixes

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

CHAPTER 1

Introduction

1. INTRODUCTION

Chapter 1 of this environmental impact statement (EIS) begins with an overview of the U.S. Department of Energy's Technical Area 18 (TA-18) Relocation proposal. Chapter 1 includes background information on the missions at TA-18, the scope of the *Draft Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (*TA-18 Relocation EIS*), and the alternatives analyzed in the EIS. Chapter 1 also discusses other National Environmental Policy Act documents related to the TA-18 Relocation proposal, as well as the scoping process used to obtain public input on the issues addressed in this EIS. The chapter concludes with the organization of the document.

1.1 OVERVIEW

1.1.1 General

The National Nuclear Security Administration (NNSA), a separately organized agency within the U.S. Department of Energy (DOE), is responsible for providing the Nation with nuclear weapons, ensuring the safety and reliability of those nuclear weapons, and supporting programs that reduce global nuclear proliferation. These mission responsibilities are accomplished through the use of DOE's core team of highly trained nuclear experts. One of the major training facilities for DOE personnel is located at Technical Area 18 (TA-18) within Los Alamos National Laboratory (LANL), Los Alamos, New Mexico. The principal TA-18 operation is the research in and the design, development, construction, and application of experiments on nuclear criticality. The objective of nuclear criticality safety is to ensure that fissile material is handled so that it remains subcritical under both normal and credible abnormal conditions to protect workers, the public, and the environment.

TA-18 supports important defense, nuclear safety, and other national security mission responsibilities. The operations at TA-18 enable DOE personnel to gain knowledge and expertise in advanced nuclear technologies that support the following: (1) nuclear materials management and criticality safety; (2) emergency response in support of counterterrorism activities; (3) safeguards and arms control in support of domestic and international programs to control excess nuclear materials; and (4) criticality experiments in support of Stockpile Stewardship and other programs. (Section 3.1 of this environmental impact statement [EIS] provides a more detailed description of the specific TA-18 operations.) The TA-18 facilities are the Nation's only facilities capable of performing general-purpose nuclear materials handling for a variety of experiments, measurements (to determine the presence of nuclear materials), and training. TA-18 also houses the Western Hemisphere's largest collection of machines for conducting nuclear safety evaluations and establishing limits for operations.

The term "stockpile stewardship" describes how DOE meets its nuclear weapons responsibilities. Stockpile stewardship includes operations associated with manufacturing, maintaining, refurbishing, assessing, surveilling, and dismantling the nuclear weapons stockpile; the activities associated with the research, design, development, simulation, modeling, and nonnuclear testing of nuclear weapons; and the assessment of safety and reliability and certification of the stockpile.

The TA-18 buildings and infrastructure, some of which have been operational since 1946, range from 30 to more than 50 years of age and are increasingly expensive to maintain and operate. The Defense Nuclear Facilities Safety Board has recommended, in 1993 and 1997, that DOE continue to maintain the capability to support the only remaining criticality safety program in the Nation (DNFSB 1993, DNFSB 1997). Consistent with this, and to reduce the long-term costs for safeguards and security, on April 11, 2000, former Energy Secretary Bill Richardson announced the proposal to relocate the TA-18 operational capabilities and materials by the end of 2004 (DOE 2000d). Pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 *et seq*.) and the DOE regulations implementing NEPA (10 CFR 1021), this *Draft Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (*TA-18 Relocation EIS*) analyzes the potential consequences to the environment associated with relocating the TA-18 operations to a new location. In the Record of Decision for this EIS, DOE anticipates selecting the new location for the TA-18 operations and implementing that decision.

1.1.2 TA-18 Facilities and Operations

As shown in **Figure 1–1**, the TA-18 developed area consists of a main building, three outlying remote-controlled Critical Assembly Storage Areas (CASAs) (formerly known as "kivas"), several smaller laboratories, nuclear material storage vaults, and support buildings. The site is located on approximately 52.61 hectares (130 acres) along Pajarito Road. The Los Alamos Critical Experiments Facility and other experimental facilities are located at TA-18, which is situated in the base of a canyon whose walls rise approximately 61 meters (200 feet) on three sides. The three CASAs are hazard Category 2 nuclear facilities (i.e., hazard analysis shows the potential for significant onsite consequences) and are within fenced areas to keep personnel at a safe distance during criticality experiments. Additionally, the entire TA-18 site is bounded by a security fence to aid in physically safeguarding special nuclear materials (SNM), and the site is designated as a security Category I facility (Category I is the highest security classification employed by DOE and is used to protect SNM from theft and/or diversion). Site access is through a guarded portal.

Under the right conditions, fissile material is capable of maintaining a self-sustaining nuclear fission chain reaction. Nuclear fission is the process by which an atom absorbs a neutron, causing it to split into two smaller atoms while releasing energy and several neutrons. When a mass of atoms produces enough neutrons to cause additional fissions so that this reaction becomes self-sustaining, a fission chain reaction has been achieved. This condition of maintaining a chain reaction at the same fission rate is called criticality, and such a system is critical. If this fission rate decreases with time and eventually shuts down, the system is considered subcritical. Conversely, if this fission rate increases with time, the system is considered supercritical.

Nuclear Facilities Hazards Classification (DOE Order 5480.23)

Category 1 Hazard: *Hazard analysis shows the potential for significant offsite consequences.*

Category 2 Hazard: *Hazard analysis shows the potential for significant onsite consequences.*

Category 3 Hazard: *Hazard analysis shows the potential for only significant localized consequences.*

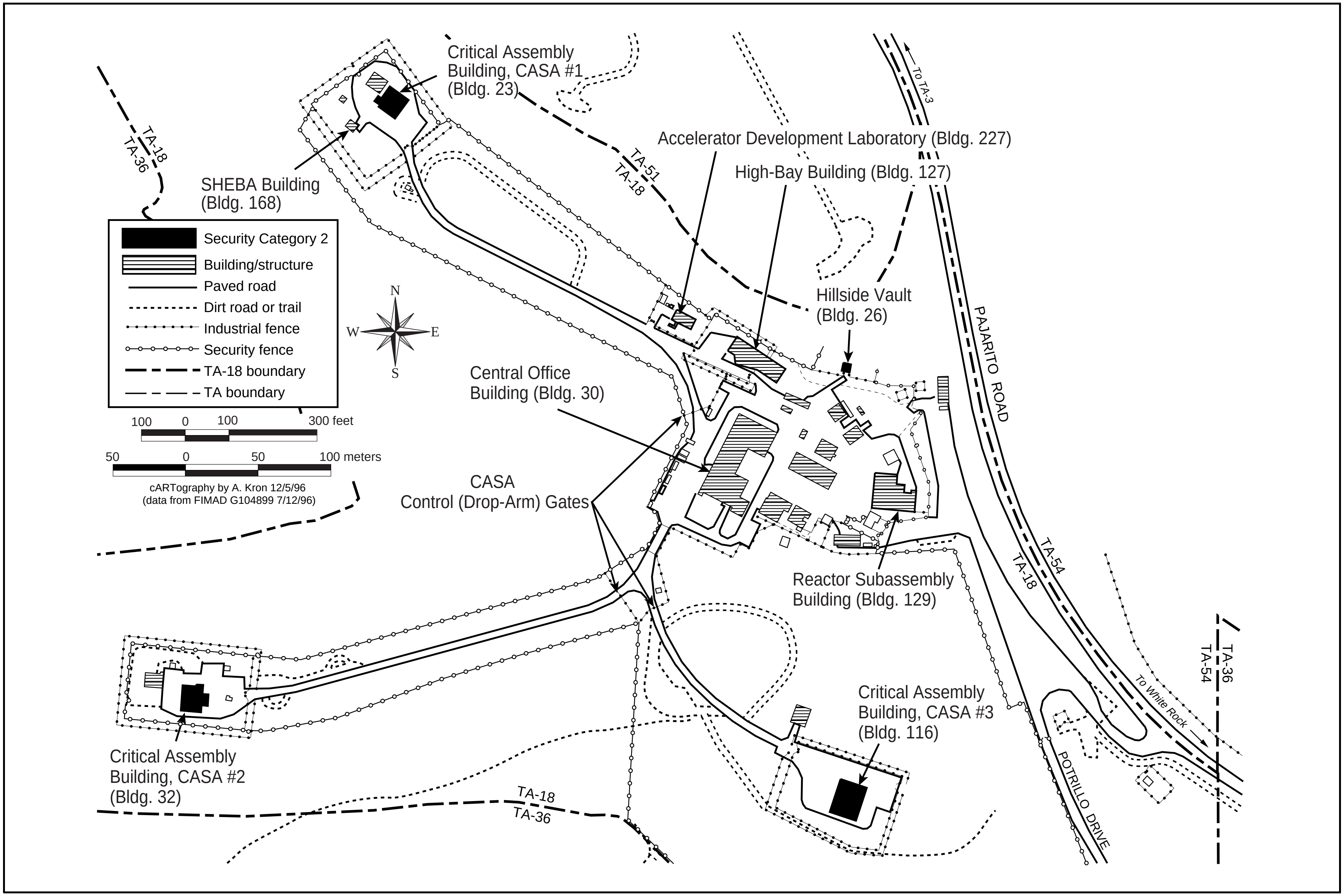


Figure 1–1 TA-18 Site

SPECIAL NUCLEAR MATERIALS SAFEGUARDS AND SECURITY (DOE Order 474.17-1A)

Special nuclear materials (SNM) are defined in the Atomic Energy Act of 1954 as (1) plutonium, uranium enriched in the isotope 233 or 235, or any other material designated as SNM; or (2) any material artificially enriched by any of the above.

DOE's policy is to protect national security and the health and safety of DOE and contractor employees, the public, and the environment by protecting and controlling SNM. This is done by designing specific safeguards and security strategies to prevent or minimize both unauthorized access to SNM and unauthorized disclosure, loss, destruction, modification, theft, compromise, or misuse of SNM as a result of terrorism, sabotage, or events such as disasters and civil disorders.

DOE uses a cost-effective, graded approach to providing SNM safeguards and security. Quantities of SNM stored at each DOE site are categorized into security Categories I, II, III, and IV, with the greatest quantities included under security Category I and lesser quantities included in descending order under security Categories II through IV. Types and compositions of SNM are further categorized by their "attractiveness," i.e., the relative ease of the processing and handling activities required to convert such materials into a nuclear explosive device. For example, assembled weapons and test devices fall under Attractiveness Level A. Pure products (i.e., metal items that can be used for weapons production in their existing form or after simple mechanical processing) are categorized under Attractiveness Level B. High-grade SNM (high-grade chemical compounds, mixtures, or metal alloys that require relatively little processing to convert them for weapons use) and low-grade SNM (bulk and low-purity materials that require extensive or complex processing efforts to convert them to metal or high-grade form) are categorized as Levels C and D, respectively. All other SNM (highly radioactive SNM not included under another attractiveness level, solutions containing very small amounts of SNM, uranium enriched to less than 20 percent uranium-235, etc.) fall under Level E. This alphanumeric system results in overall categories ranging from security Category IA (weapons and test devices in any quantities) to security Category I'VE (reportable quantities of SNM not included in other categories). Some of the terms used in this EIS to refer to SNM safeguards and security measures are defined below.

A Perimeter Intrusion Detection and Assessment System (PIDAS) is a mutually supportive combination of barriers, clear zones, lighting, electronic intrusion detection, assessment, and access control systems designed to detect, impede, control, or deny access to a Material Access Area, Protected Area, or Vital Area.

A **Material Access Area** is a security area authorized to contain a security Category I quantity of SNM. Material Access Areas have defined physical barriers, are located within a Protected Area, and are subject to specific access controls.

A **Protected Area** is a security area defined by physical barriers (walls or fences) to which access is controlled. Protected Areas are designed to protect security Category II SNM and classified material and/or to provide a security zone around a Material Access Area or Vital Area.

A **Vital Area** is a security area located within a Protected Area that has a separate perimeter and access controls, including intrusion detection, to provide layered protection of vital equipment.

An **SNM Vault** is a penetration-resistant, windowless enclosure equipped with an intrusion alarm system that is activated by opening the door. The walls, floor, and ceiling of an SNM Vault are constructed of materials that provide penetration resistance equivalent to a minimum of 8-inch-thick reinforced concrete. Further protection is provided by a built-in, combination-locked steel door that, in newer structures, meets the standards set forth in Federal Specification AA-D-6008 of the Federal Specifications and Standards (41 CFR 101).

A **Design-Basis Threat** is a potential threat that is assumed for the purpose of establishing requirements for safeguards and security programs and related systems, components, equipment, information, or material.

The primary operation at TA-18 is the performance of criticality experiments. Criticality experiments involve systems of fissile material(s), called critical assemblies, which are designed to reach a condition of nuclear criticality. The capability to conduct criticality experiments also includes development of nuclear instruments, measurement and evaluation of integral cross sections, accident simulation, dosimetry, and the detection and characterization of nuclear material. A critical assembly is a machine used to manipulate a mass of fissile material in a specific geometry and composition. The movement or addition of fissile material in the critical assembly can allow it to reach the condition of nuclear criticality and control the reactivity. A critical assembly is a small version (i.e., from several inches to several feet) of a nuclear power plant core. Fissile materials that can be used in a critical assembly typically consist of one of the following five main isotopes: uranium-233, uranium-235, neptunium-237, plutonium-239, or plutonium-241, in a specific composition and shape. A neutron source may be placed near the assembly to ensure the fission rate of the critical assembly can be readily observed as it approaches and reaches criticality. The quantity of fissile material capable of sustaining such a reaction is called the critical mass for that assembly. Critical mass is a function of many factors including the mass and enrichment of the fissile material; the geometry, or shape, of the assembly; and the presence of reflectors or neutron absorbers.

Since 1948, thousands of experiments with several fissile materials (uranium-235 and uranium-233, isotopes of plutonium, and neptunium-237) have been conducted at TA-18. These experiments have been performed with metal or compounds, both bare and reflected, as solid, liquid, and gas throughout the entire range of fast, intermediate, and thermal neutron spectra. Critical assemblies at TA-18 are designed to operate at low-to-average power and at temperatures well below the fissile material temperature operating limits (which sets them apart from normal reactors), with low fission-product production and minimal fission-product inventory. (See text box below for a discussion of a typical critical assembly.) SNM is stored in either CASAs or in the Hillside vault. The onsite TA-18 nuclear material inventory is relatively stable and consists primarily of isotopes of plutonium and uranium. The bulk of the plutonium is metal and is either clad or encapsulated. The use of toxic and hazardous materials is limited. (Section 3.1 of this EIS contains a more detailed description of the specific facilities and operations at TA-18.)

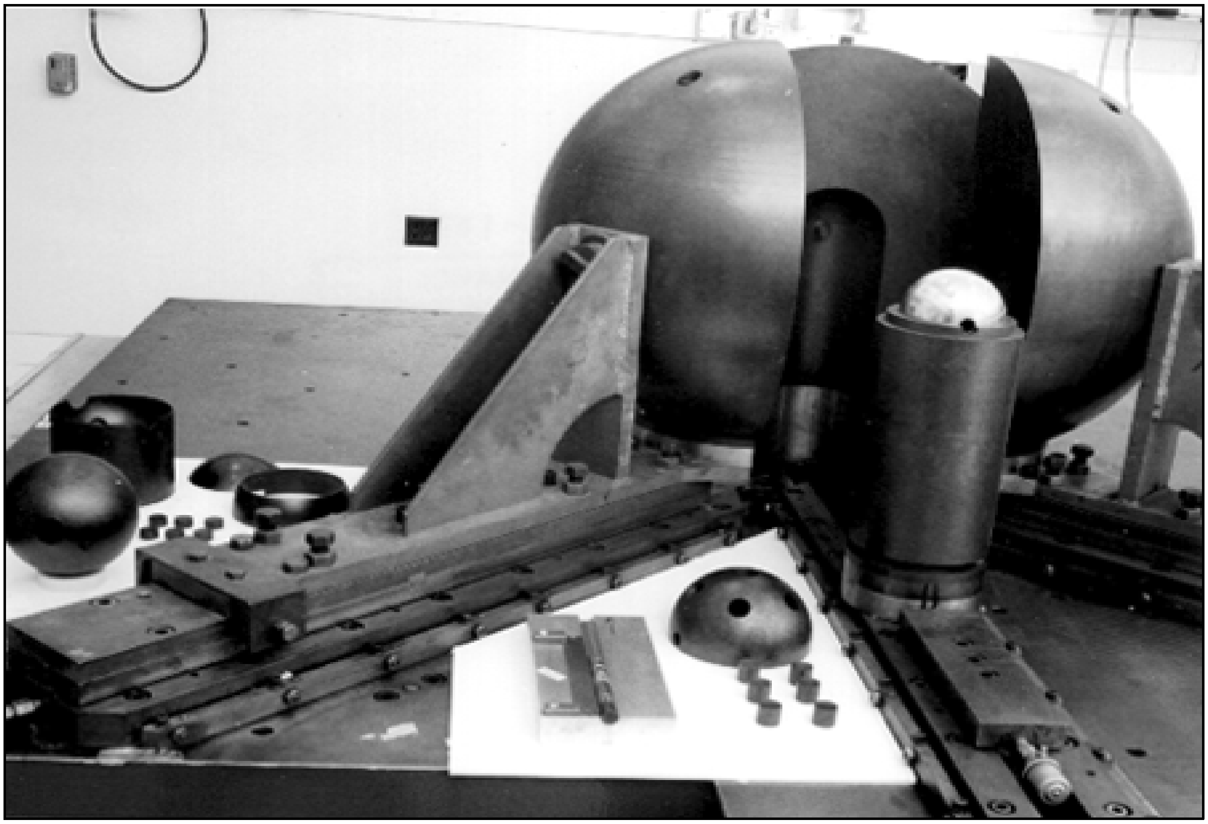
1.2 Proposed Action, EIS Scope, and Alternatives

DOE proposes to relocate the TA-18 operational capabilities and materials to a new location and continue to perform those operations at the new location for the foreseeable future (for purposes of this EIS, the operations are assessed for a 25-year operating period). As described below, the EIS evaluates four alternative locations for the proposed action, as well as a TA-18 Upgrade Alternative and the No Action Alternative. The proposed action includes: transport of critical assembly machines and support equipment to a new location; modification of existing facilities to support the TA-18 operations; or construction and operation of "new" facilities for 25 years to support the TA-18 operations. Relocation of TA-18 operations would also include transport of up to approximately 2.4 metric tons (2.6 tons) of SNM associated with the TA-18 operations and a range of disposition options associated with the existing TA-18 facilities that would be vacated if the operations are relocated.

The *TA-18 Relocation EIS* evaluates the potential direct, indirect, and cumulative environmental impacts associated with the proposed action of relocating TA-18 capabilities and materials to a new location. Location alternatives include the following DOE sites: (1) a different site at LANL (the Preferred Alternative) at Los Alamos, New Mexico; (2) the Sandia National Laboratories/New Mexico (SNL/NM) at Albuquerque, New Mexico; (3) the Nevada Test Site (NTS) near Las Vegas, Nevada; and (4) the Argonne National Laboratory-West (ANL-W) near Idaho Falls, Idaho. These alternatives were developed by a DOE-wide Option Study Group (Group) chartered to develop reasonable alternatives for conducting TA-18 mission operations. The Group developed criteria that screened for sites with existing security Category I infrastructure; nuclear environmental, safety, and health infrastructure; and compatibility between the site

TYPICAL CRITICAL ASSEMBLY

Critical assembly designs at TA-18 use different methods to reach a critical condition. In some cases, additional fissile material is added in discrete quantities to an existing configuration. Other criticality assembly designs allow for a constant mass of fissile material, in two or more separate components, to be moved closer together in small increments. Some critical assembly systems incorporate movable neutron-absorbing components, which can be moved into and out of the fissile material mass to control the fission reaction. Critical assemblies can be composed of fissile materials in either solid or liquid form. For example, a critical assembly could range from a small 15-centimeter (6-inch) sphere of plutonium-239 metal with a mass of about 6 kilograms (13.2 pounds) to larger quantities of enriched uranium-235 in various shapes. An example of a critical assembly used in the TA-18 facility is the Flattop assembly, shown below. This assembly, including all of its structure, has a base of approximately 2.4 x 1.8 meters (8 x 6 feet) and a height of 1.5 meters (5 feet). The fissile material is a 15-centimeter (6-inch) sphere of enriched uranium (93 percent uranium-235) metal or plutonium-239 metal, reflected by the natural uranium hemisphere blocks.



Flattop Critical Assembly

and TA-18 operational capabilities (Section 3.2.2 provides a more detailed description of the site selection process). This EIS also analyzes the upgrade of TA-18 facilities at LANL and the No Action Alternative. These alternatives are described briefly below and in greater detail in Section 3.3 of this EIS.

<u>TA-18 Upgrade Alternative</u>—This alternative would involve upgrading the buildings, infrastructure and security infrastructure of the existing TA-18 facilities to continue housing these TA-18 operations at their present location at LANL. Under this alternative, some construction activities would be necessary.

<u>LANL New Facility Alternative</u>—This alternative would involve housing the security Category I/II activities in a new building to be constructed near the Plutonium Facility 4 at TA-55. Under this

alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at TA-39 or remain at TA-18; the rest of the security Category III/IV activities would either be relocated to a new structure at TA-55 or remain at TA-18.

SNL/NM Alternative—This alternative would involve the housing of the security Category I/II TA-18 operations within a new security Category I/II facility within TA-V[1] at SNL/NM. Currently, SNL/NM operates a variety of research-oriented nuclear facilities at TA-V. A new underground facility and modifications to existing buildings are proposed to accommodate the TA-18 operations. Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at LANL's TA-39 or remain at TA-18; the rest of the security Category III/IV activities would remain at TA-18.

NTS Alternative—This alternative would involve the housing of the security Category I/II TA-18 operations in and around the existing Device Assembly Facility (DAF). Currently, DAF is used for the assembly of subcritical assemblies, as well as other miscellaneous national security missions. Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at LANL's TA-39 or remain at TA-18; the rest of the security Category III/IV activities would remain at TA-18.

ANL-W Alternative—This alternative would involve the housing of the security Category I/II TA-18 operations in the existing Fuel Manufacturing Facility (FMF) and other existing buildings at ANL-W. New construction and expansion of the existing FMF are proposed to accommodate the TA-18 operations. Security upgrades would also be necessary. Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at LANL's TA-39 or remain at TA-18; the rest of the security Category III/IV activities would remain at TA-18.

No Action Alternative—As required by Council on Environmental Quality regulations, the *TA-18 Relocation EIS* also evaluates the No Action Alternative of maintaining the TA-18 operations at the current location. This alternative would maintain the current operations at TA-18 as described in the Expanded Operations Alternative of the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (*LANL SWEIS*) (DOE 1999b) and the associated Record of Decision (64 FR 50797, September 20, 1999). No upgrades or alternatives of either building, infrastructure, or security infrastructure would occur.

1.3 Decisions to be Made

Based on the analytical results of this EIS as well as cost, schedule, safeguards and security issues, and other programmatic considerations, which are not part of this EIS, DOE intends to make the following decisions concerning the security Category I/II, SHEBA, and other security Category III/IV activities currently being conducted at LANL's TA-18 facilities:

- Whether to relocate the security Category I/II activities from TA-18 to a new location or maintain these mission support operations at their current location with or without upgraded facilities. If a decision is made to relocate the security Category I/II mission activities, to select one of four proposed relocation sites (i.e., TA-55 at LANL, TA-V at SNL/NM, DAF at NTS, or ANL-W)

- Whether to relocate some or all security Category III/IV activities to new and/or other locations at LANL (SHEBA activities to TA-39; other security Category III/IV activities to TA-55), or maintain these operations at their current location with or without upgraded facilities

[1] *Technical areas at SNL/NM are designated using roman numerals rather than the arabic numerals used at LANL.*

The analysis in this EIS will support decision making related to eventual site-specific construction and operation activities for any alternative selected.

1.4 OTHER RELEVANT NEPA REVIEWS

This section explains the relationship between the *TA-18 Relocation EIS* and other relevant NEPA documents and DOE programs. Completed NEPA compliance actions are addressed in Section 1.4.1; ongoing actions are discussed in Section 1.4.2.

1.4.1 Completed NEPA Compliance Actions

1.4.1.1 Final Environmental Assessment for Device Assembly Facility Operations (DOE/EA-0971)

The *Final Environmental Assessment for Device Assembly Operations* (DOE 1995d) was issued in May 1995 and evaluates the proposed action to open and operate DAF at NTS. Since DAF had already been constructed, this environmental assessment (EA) focused on potential impacts resulting from operation of the facility. These operations generally include assembly, disassembly or modification, staging, transportation, testing, maintenance, repair, retrofit, and surveillance of nuclear explosives. Such operations have previously been conducted at NTS in older facilities located in Area 27. DAF also provides enhanced capabilities in a state-of-the-art facility for the safe, secure, and efficient handling of high explosives in combination with SNM (plutonium and highly enriched uranium). Based upon the information and the analyses presented in the EA, DOE determined that there would be no significant impacts associated with the proposed action. The Finding of No Significant Impact was signed on June 8, 1995. DAF is one of the facilities considered under the proposed action to receive relocated TA-18 activities.

1.4.1.2 Environmental Assessment for Consolidation of Certain Materials and Machines for Nuclear Criticality Experiments and Training – Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/EA-1104)

In May 1996, DOE issued the EA and Finding of No Significant Impact for Consolidation of Certain Materials and Machines for Nuclear Criticality Experiments and Training – Los Alamos National Laboratory (DOE 1996c). This EA compared the effects of consolidating nuclear criticality experiments machines and materials at the Los Alamos Critical Experiments Facility (LACEF) at LANL's TA-18. Actions consolidated through this EA resulted in the program which exists today and form the basis for the No Action Alternative presented in the *TA-18 Relocation EIS*.

1.4.1.3 Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement (DOE/EIS-0240)

In June 1996, DOE issued the *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (DOE 1996d). DOE prepared this EIS because of the need to move rapidly to neutralize the proliferation threat of surplus highly enriched uranium and to demonstrate the United States' commitment to nonproliferation. The *Highly Enriched Uranium EIS* evaluated management alternatives for materials used by TA-18 activities. Alternatives considered include several approaches to blending down the highly enriched material to make it non-weapons-usable and suitable for fabrication into fuel for commercial nuclear reactors. In the Record of Decision, published in the *Federal Register* on August 5, 1996 (61 FR 40619), DOE stated it would implement a program that would blend as much as 85 percent of the surplus highly enriched uranium to a uranium-235 enrichment level of approximately 4 percent for commercial use and blend the remaining surplus highly enriched uranium down to an enrichment level of about 0.9 percent for disposal as low-level radioactive waste. Highly enriched uranium used in support of TA-18 activities could be dispositioned, when necessary, using material management methods described in the *Highly Enriched Uranium EIS*.

1.4.1.4 Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (DOE/EIS-0243)

In August 1996, DOE issued the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 1996e). This document analyzed four alternatives: (1) the No Action Alternative, (2) Discontinuation of Operations, (3) Expanded Use, and (4) Alternate Use of Withdrawn Lands. On December 13, 1996, DOE published the Record of Decision in the *Federal Register* (61 FR 65551), selecting a combination of Alternatives 1, 3, and 4, with most activities pursued at levels described in the Expanded Use Alternative. As described in the Record of Decision, defense program activities at NTS will emphasize stockpile stewardship experiments and operations to maintain confidence in the safety and reliability of the stockpile without underground nuclear testing. DOE plans to conduct a wide variety of experiments within the appropriately zoned areas of NTS. Existing facilities, including DAF and Area 27, will be used to prepare the explosives, SNM, and other material required for these experiments. The Record of Decision also identified that DOE will reserve land and infrastructure on NTS to support current test readiness and national security missions and to support future defense program activities. It further states that DOE will establish a Defense Industrial Zone around critical assembly areas. This zone is dedicated solely to defense-related activities and is an area in which various future stockpile stewardship and management facilities could be sited. The proposed action to relocate the TA-18 capabilities and materials is consistent with the decisions documented in the Record of Decision for this EIS.

1.4.1.5 Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management (DOE/EIS-0236)

In September 1996, DOE issued the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996f). This programmatic EIS evaluated the potential environmental impacts resulting from activities associated with nuclear weapons research, design, development, and testing, as well as the assessment and certification of the weapons' safety and reliability. The stewardship portion of the document analyzed the development of three new facilities to provide enhanced experimental capabilities. The Record of Decision was published in the *Federal Register* on December 26, 1996 (61 FR 68014). In the Record of Decision, DOE elected to downsize a number of weapons complex facilities, to build the National Ignition Facility at Lawrence Livermore National Laboratory, and to reestablish pit fabrication capability at LANL. A supplement analysis (DOE/EIS-0236-SA, September 1999) was prepared to examine the plausibility of a building-wide fire at LANL's plutonium facility and to examine new studies regarding seismic hazards at LANL. The supplement analysis concluded that there is no need to prepare a supplemental EIS. The impacts of this action have been included in the baseline assessment of each candidate site and, therefore, are included in the potential cumulative impacts resulting from the *TA-18 Relocation EIS* proposed action. In addition, as identified in the *TA-18 Relocation EIS* Notice of Intent (65 FR 25472), criticality experiments at TA-18 support the stockpile stewardship mission addressed in this programmatic EIS.

1.4.1.6 Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory (DOE/EIS-0238)

In January 1999, DOE issued the *LANL SWEIS* (DOE 1999b). This document assessed four alternatives for the operation of LANL: (1) No Action, (2) Expanded Operations, (3) Reduced Operations, and (4) Greener Alternative. The Record of Decision for the *LANL SWEIS* was published in the *Federal Register* on September 20, 1999 (64 FR 50797). In the Record of Decision, DOE selected the Expanded Operations

Alternative. This alternative includes the continuation of all activities presently undertaken at LANL, at the highest level of activity, and an increased pit production capability. Consistent with that Record of Decision, operations at TA-18 would continue, and activities would increase by approximately 25 percent over past No Action operational levels. During the time that the *LANL SWEIS* was in preparation, DOE did not envision the current proposal to relocate the TA-18 operations or upgrade the existing TA-18 facilities, and, thus, that proposal was not included in the *LANL SWEIS*. The No Action Alternative assessed in this *TA-18 Relocation EIS* is consistent with the Preferred Alternative chosen through the *LANL SWEIS* Record of Decision.

1.4.1.7 Idaho National Engineering and Environmental Laboratory Advanced Mixed Waste Treatment Project Final Environmental Impact Statement (DOE/EIS-0290)

The *Idaho National Engineering and Environmental Laboratory Advanced Mixed Waste Treatment Project Final Environmental Impact Statement* (DOE 1999a) was issued in March 1999 and assessed the potential environmental impacts associated with four alternatives related to the construction and operation of the Advanced Mixed Waste Treatment Facility at the Idaho National Engineering and Environmental Laboratory (INEEL). The alternatives analyzed were: (1) a No Action Alternative, under which existing waste management operations, facilities, and projects would continue; (2) the proposed action/Preferred Alternative, under which BNFL, Inc., would build and operate an advanced mixed waste treatment project facility using proposed thermal and nonthermal treatment technologies for certification and shipment to the Waste Isolation Pilot Plant or to another acceptable disposal facility; (3) a nonthermal treatment alternative, under which some treatment of transuranic, alpha, and low-level mixed radioactive waste would occur at an advanced mixed waste treatment project facility at the same location as the proposed action, and waste that requires thermal treatment would be repackaged for storage; and (4) a treatment and storage alternative that would include the same processes as the proposed action/Preferred Alternative, except the treated waste would be placed in Resource Conservation and Recovery Act–permitted storage units at the onsite Radioactive Waste Management Complex at INEEL for long-term storage. The Record of Decision was published in the *Federal Register* on April 7, 1999 (64 FR 16948). In the Record of Decision, DOE selected the Preferred Alternative, although construction of the thermal treatment component of this alternative has been deferred pending the recommendation of a blue-ribbon panel of experts assessing possible technology alternatives. The impacts of the action DOE decided to implement are factored into the assessment of potential cumulative impacts discussed in the *TA-18 Relocation EIS* proposed action.

1.4.1.8 Final Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico (DOE/EIS-0281)

In October 1999, DOE issued the *Final Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico* (*SNL/NM SWEIS*) (DOE 1999f). This document analyzed three broad alternative levels of operation at SNL/NM: (1) the No Action Alternative, (2) an Expanded Operations Alternative, and (3) a Reduced Operations Alternative. The Record of Decision for the *SNL/NM SWEIS* was published in the *Federal Register* on December 15, 1999 (64 FR 69996). In the Record of Decision, DOE selected the Expanded Operations Alternative, without the Microsystems and Engineering Sciences Applications (MESA) Complex. Under the Expanded Operations Alternative presented in the *SNL/NM SWEIS* (exclusive of the MESA Complex), activity at TA-V would result in the highest reasonably foreseeable activity levels that could be supported by current facilities and the potential expansion and construction of new facilities. The proposal to relocate TA-18 to TA-V was not envisioned at the time the *SNL/NM SWEIS* was in preparation. The proposed action to relocate the TA-18 capabilities and materials is consistent with the decisions documented in the *SNL/NM SWEIS* Record of Decision.

1.4.1.9 Surplus Plutonium Disposition Final Environmental Impact Statement (DOE/EIS-0283)

In November 1999, DOE issued the *Surplus Plutonium Disposition Final Environmental Impact Statement*, (DOE 1999i), an EIS that was tiered from the *Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement* (DOE/EIS-0229). The Record of Decision for the programmatic EIS, published in the *Federal Register* on January 14, 1997 (62 FR 3014), outlined DOE's approach to plutonium disposition and established the groundwork for the *Surplus Plutonium Disposition EIS*. The fundamental purpose of the program is to ensure that plutonium produced for nuclear weapons and declared excess to national security needs (now and in the future) will never again be used for nuclear weapons.

The *Surplus Plutonium Disposition EIS* evaluated reasonable alternatives for the siting, construction, and operation of facilities required to implement DOE's disposition strategy for up to 50 metric tons of surplus plutonium. The disposition facilities analyzed in this EIS include pit disassembly and conversion, plutonium conversion and immobilization, and mixed oxide fuel fabrication. The *Surplus Plutonium Disposition EIS* also analyzed the potential impacts of fabricating a limited number of mixed oxide fuel assemblies for testing in a reactor.

In the Record of Decision, published in the *Federal Register* on January 11, 2000 (65 FR 1608), DOE decided to provide for the safe and secure disposition of up to 33 metric tons of surplus plutonium as mixed oxide fuel and up to 17 metric tons of surplus plutonium through immobilization. DOE also decided to construct and operate each of the three disposition facilities at the Savannah River Site, fabricate the lead assemblies at LANL, and conduct postirradiation examination of the lead assemblies at Oak Ridge National Laboratory. Plutonium used in support of TA-18 activities could be dispositioned, when necessary, using material management methods described in the *Surplus Plutonium Disposition EIS*.

1.4.1.10 Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel (DOE/EIS-0306)

In July 2000, DOE issued the *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (DOE 2000e). This document evaluates strategies to remove or stabilize the reactive sodium contained in a portion of DOE's spent nuclear fuel inventory to prepare the spent nuclear fuel for disposal in a geologic repository. The EIS analyzes, under the proposed action, six alternatives that employ one or more of the following technology options at nuclear fuel management facilities at the Savannah River Site or INEEL: electrometallurgical treatment, the plutonium-uranium extraction process, packaging in high-integrity cans, and the melt and dilute treatment process. The Record of Decision was published in the *Federal Register* on September 19, 2000 (65 FR 56565). In the Record of Decision, DOE decided to implement the Preferred Alternative of electrometallurgically treating the Experimental Breeder-II spent nuclear fuel and miscellaneous small lots of sodium-bonded spent nuclear fuel at ANL-W at INEEL. Because of the different physical characteristics of the Fermi-1 sodium-bonded blanket spent nuclear fuel also analyzed in the EIS, DOE decided to continue to store this material while alternative treatments are evaluated. The proposed action under this EIS contributes to the cumulative impacts at the site discussed in the *TA-18 Relocation EIS*.

1.4.1.11 Special Environmental Analysis for the Department of Energy, National Nuclear Security Administration: Actions Taken in Response to the Cerro Grande Fire at Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/SEA-03)

In September 2000, DOE and NNSA issued this special environmental analysis (SEA) to document their assessment of impacts associated with emergency activities conducted at LANL, Los Alamos County, New Mexico, in response to the recent wildfire known as the Cerro Grande Fire (DOE 2000h). This wildfire burned about 3,061 hectares (7,650 acres) within the boundaries of LANL and about an additional 14,200 hectares (35,500 acres) in neighboring areas. As a result of this wildfire, DOE identified the need to take action on an emergency basis to protect human life, property, and the environment. DOE considered that its actions should not be protective of the lives of only its employees, contractors, and subcontractors, but also the lives of all people living and working in the LANL region. DOE also considered that its actions should not protect property belonging to only the U.S. Government, but also the properties of neighboring and downstream landowners and residents.

DOE would normally prepare an EA or EIS in compliance with NEPA, as amended, to analyze potentially significant beneficial or adverse impacts that could occur if a proposed action were implemented. However, because of the urgent nature of the actions required by DOE to address the effects of the Cerro Grande Fire as it burned over LANL and the need for immediate postfire recovery and protective actions, DOE had to act immediately. DOE was, therefore, unable to comply with NEPA in the usual manner. DOE thereby invoked the Council on Environmental Quality's emergency circumstances clause of its NEPA Implementing Regulations (40 CFR 1506.11) and the emergency circumstances clause of DOE's own NEPA implementing regulations (10 CFR 1021.343). This SEA provides the reader with an assessment of the impacts that have resulted because of actions undertaken by DOE (or undertaken on behalf of DOE by other parties at DOE's direction or with DOE funding) to address a major disaster emergency situation. The SEA includes descriptions of actions; resulting impacts from actions; mitigation measures taken for actions that render their impacts not significant or that lessen the adverse effects of the actions; and an analysis of cumulative impacts. Unlike an EA or EIS produced in the course of routine NEPA compliance, this SEA does not include an impact assessment of alternative actions that DOE could have taken to meet its purpose and need for action. Nor does it include an assessment of the No Action Alternative. Furthermore, DOE will not issue a formal Record of Decision based on this SEA. However, actions not included in this SEA will be the subject of other NEPA reviews and analyses. Actions taken in response to this SEA are included in the baseline conditions for the No Action Alternative in the *TA-18 Relocation EIS*.

1.4.1.12 Environmental Assessment for the Microsystems and Engineering Sciences Applications Complex (DOE/EA-1335)

The *Environmental Assessment for the Microsystems and Engineering Sciences Applications Complex* (DOE 2000g) was issued in September 2000 and analyzed the potential effects of constructing several new facilities and upgrading existing facilities for the purposes of consolidating operations currently conducted at several SNL/NM facilities and modernizing SNL/NM's capabilities in microsystems design and production. The proposed action involves renovation of and upgrades to the Microelectronics Development Laboratory; construction of three new facilities; relocation of the activities currently conducted at the Compound Semiconductor Research Laboratory and several other buildings to the new facilities; and demolition of the Compound Semiconductor Research Laboratory at SNL/NM. Collectively, the new facilities would be known as the MESA Complex. Based on the analysis presented in the EA and the concerns of interested stakeholders, DOE found that there would be no significant impacts associated with the proposed action. The Finding of No Significant Impact was signed on October 16, 2000. The impacts of this action are factored into the assessment of potential cumulative impacts at SNL/NM in the *TA-18 Relocation EIS*.

1.4.1.13 Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility (Nuclear Infrastructure Programmatic EIS) (DOE/EIS-0310)

This *Nuclear Infrastructure Programmatic EIS* (DOE 2000k) was issued in December 2000. Under the authority of the Atomic Energy Act of 1954, as amended, DOE is responsible for ensuring the availability of isotopes for medical, industrial, and research applications; meeting the nuclear material needs of other Federal agencies; and undertaking research and development activities related to development of nuclear power for civilian use. To meet these responsibilities, DOE maintains nuclear infrastructure capabilities that support various missions. Current estimates for the future needs of medical and industrial isotopes, plutonium-238, and research requirements indicate that the current infrastructure may soon be insufficient to meet the projected demands. In the *Nuclear Infrastructure Programmatic EIS*, DOE proposed to enhance these capabilities to provide for (1) production of isotopes for medical and industrial uses; (2) production of plutonium-238 for use in advanced radioisotope power systems for future National Aeronautics and Space Administration space exploration missions; and (3) the Nation's nuclear research and development needs for civilian application.

The *Nuclear Infrastructure Programmatic EIS* evaluated the environmental impacts of a No Action Alternative (maintaining status quo), four alternative strategies to accomplish this mission, and an alternative to permanently deactivate the Fast Flux Test Facility (FFTF), with no new missions. Alternatives 2, 3, and 4 also include permanent deactivation of FFTF. The alternatives considered were the No Action Alternative; (1) Restart FFTF at Hanford, Washington; (2) Use Only Existing Operational Facilities; (3) Construct One or Two New Accelerators; (4) Construct a New Research Reactor; and (5) Permanently Deactivate FFTF (with no new missions).

In the Record of Decision which was published in the *Federal Register* on January 26, 2001 (66 FR 7877), DOE selected the Preferred Alternative (Alternative 2, Option 7, Use Only Existing Operational Facilities). DOE will reestablish domestic production of plutonium-238, as needed, using the Advanced Test Reactor at INEEL in Idaho and the High Flux Isotope Reactor at the Oak Ridge National Laboratory in Tennessee and will process irradiated plutonium-238 targets at the Radiochemical Engineering Development Center in Tennessee. DOE will permanently deactivate FFTF. The impacts of this action are factored into the assessment of potential cumulative impacts at INEEL in the *TA-18 Relocation EIS*.

1.4.1.14 Final Environmental Assessment for Atlas Relocation and Operation at the Nevada Test Site (DOE/EA-1381)

In May 2001, DOE issued the *Final Environmental Assessment for Atlas Relocation and Operation at the Nevada Test Site* (DOE 2001c). This document assesses the environmental effects of DOE's proposed action to disassemble the Atlas pulsed-power machine at LANL and transport it to NTS, where it would be reassembled in a new building in Area 6 north of DAF. After reassembly, Atlas would be recommissioned to ensure proper operation and then used to conduct as many as 100 pulsed-power experiments per year, depending on Stockpile Stewardship Program requirements. The proposed action of moving the Atlas machine to NTS does not represent a major change in the Stockpile Stewardship Program, but rather a relocation of an asset within the DOE complex. The potential effects of this action are factored into the assessment of potential cumulative impacts resulting from the *TA-18 Relocation EIS* proposed action.

1.4.2 Ongoing NEPA Compliance Actions

1.4.2.1 Idaho High-Level Waste and Facilities Disposition Draft Environmental Impact Statement (DOE/EIS-0287)

The *Idaho High-Level Waste and Facilities Disposition Draft Environmental Impact Statement* (DOE 1999j) was issued in December 1999. It evaluates alternatives for managing the high-level radioactive waste and associated radioactive waste and facilities at INEEL. Under the terms of the 1995 Settlement Agreement and Consent Order with the State of Idaho, DOE agreed to treat high-level radioactive waste currently stored at INEEL and to prepare the waste in a form ready to be shipped out of the State of Idaho by 2035. The purpose of this EIS is to assist DOE in making decisions concerning the management of this radioactive waste to ensure compliance with applicable laws and regulations and to protect the environment and the health and safety of the workers and the public in a cost-effective manner.

In this EIS, DOE evaluates reasonable alternatives and options for the treatment of high-level radioactive waste, sodium-bearing waste, newly generated waste, and the disposition of facilities associated with high-level radioactive waste generation, treatment, and storage at INEEL. In addition, this EIS is integrated with the ongoing Comprehensive Environmental Response, Compensation, and Liability Act program at the Idaho Nuclear Technology and Engineering Center. The proposed action under this EIS contributes to the cumulative impacts at INEEL discussed in the *TA-18 Relocation EIS*.

1.4.2.2 Sandia Underground Reactor Facility Environmental Assessment

DOE is in the process of preparing an EA for construction and operation of the Sandia Underground Reactor Facility, an underground facility designed for housing the Sandia Pulsed Reactor and other possible missions at TA-V, should they be relocated within SNL/NM. This EA is expected to be completed in 2001. If implemented, the construction and operation of this facility would parallel the construction and operation of the facility proposed for the TA-18 operational capabilities and material storage at SNL/NM.

1.4.3 Relationships to Other LANL Projects

DOE routinely conducts planning activities at its sites to identify long-term strategies and options for maintaining infrastructure in support of various missions. As part of these efforts, potential projects or actions are identified as options for future consideration. Many of these projects never go beyond the initial planning phases due to various factors such as insufficient justification or inadequate funding.

DOE has initiated a planning effort that focuses on the long-term strategy for conducting security Category I nuclear operations at LANL. Security Category I nuclear operations at TA-18 are discussed in Section 1.1.2. While proposals regarding TA-18 activities may fall within the scope of this plan along with other activities such as analytical chemistry, security, and pit manufacturing, DOE has determined that the TA-18 relocation proposal must move forward independent of this broader planning effort to ensure continuous mission support. Many of the activities in this planning effort are in the preliminary phase of consideration and the effort is too speculative at the present time for NEPA analysis. To the extent sufficient information is available, this draft EIS discusses the potential cumulative impacts from other reasonably foreseeable activities at LANL.

1.5 SCOPING PROCESS

Scoping is a process in which the public and stakeholders provide comments directly to the Federal agency on the scope of the EIS. This process is initiated by the publication of the Notice of Intent in the *Federal Register*.

On May 2, 2000, NNSA published a Notice of Intent to prepare the *TA-18 Relocation EIS* (65 FR 25472). In this Notice of Intent, DOE invited public comment on the *TA-18 Relocation EIS* proposal. Subsequent to this notice, DOE held public scoping meetings in the vicinity of all sites that might be affected by the proposed action. Public scoping meetings were held as follows: (1) May 18–Albuquerque, New Mexico; (2) May 23–North Las Vegas, Nevada; (3) May 25–Idaho Falls, Idaho; and (4) May 30–Española, New Mexico (note: this public meeting was originally scheduled for May 17 at Los Alamos, New Mexico, but was rescheduled and relocated due to the Cerro Grande Fire).

All comments received, orally and in writing at these meetings, via mail, fax, the Internet, and the toll-free phone line, were reviewed for consideration by DOE in preparing this EIS. A listing of the comments received during the public scoping process, as well as DOE's consideration of these comments, is provided in Appendix I of this EIS.

Summary of Major Comments

Many of the verbal and written comments received during the public scoping period identified the need for DOE to describe in detail the existing TA-18 capabilities and processes, as well as the specific requirements associated with the alternatives for fulfilling DOE’s mission support needs. In particular, comments addressed the suitability of other sites to perform these mission support needs, the design of any buildings to be constructed or modified, construction and operation timelines, and controls to limit releases to the environment.

A significant number of comments also expressed concern about the costs associated with operating TA-18 criticality experiments facilities or relocating these capabilities elsewhere. These comments suggested that detailed cost analyses be conducted to analyze the construction, operation, security, and transportation needs of the various alternatives.

Many comments also addressed both the SNM needed to support, and the waste streams resulting from, TA-18 operations. Commentors requested clarification about the amount of SNM that would be required under each alternative, the manner and routes of its transport, and the availability of suitable shipping containers. Waste management concerns expressed by commentors included the need to identify the types and volumes of waste generated by the proposed action; the facilities available at each site to treat, store, or dispose of the waste; transportation requirements; and compatibility of the proposed action with state and Federal regulations.

Several commentors expressed concern about environmental, health, and safety risks associated with TA-18 operations. DOE representatives were urged to thoroughly evaluate the potential consequences of the proposed action on local wildlife, water resources, and the health and safety of area residents, and to address the Cerro Grande Fire at LANL in this EIS. Comments also suggested that the EIS quantify all radionuclide and chemical emissions resulting from the proposed action. Concerns were raised about the safety and security of TA-18 facilities and how safety and security would be addressed at each of the proposed relocation sites. Commentors expressed favor or opposition for a particular relocation alternative, reasons for which included security, cost, and workforce advantages.

Major issues identified through both internal DOE and public scoping are addressed in this EIS by analyses in the following areas:

- Land resources, including land use and visual resources
- Site infrastructure
- Air quality and acoustics
- Water resources, including surface water and groundwater
- Geology and soils
- Biotic resources, including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species
- Cultural and paleontological resources, including prehistoric resources, historic resources, and Native American resources
- Socioeconomics, including regional economic characteristics, demographic characteristics, housing and community services, and local transportation
- Radiological and hazardous chemical impacts during normal operations and accidents
- Waste management
- Transportation of nuclear materials

In addition to analyses in these areas, the EIS also addresses monitoring and mitigation, unavoidable impacts and irreversible and irretrievable commitment of resources, and impacts of long-term productivity.

1.6 ORGANIZATION OF THIS EIS

This EIS consists of two volumes. Volume I contains the main analyses, while Volume II contains technical appendices that support the analyses in Volume I, along with additional project information. An Executive Summary is available as a separate publication. Volume I contains 11 chapters. The 11 chapters include the following information:

Chapter 1 – Introduction
Background on the TA-18 Relocation Project, proposed action, EIS scope, and alternatives; the relationship of this EIS to other DOE NEPA actions and programs; and issues identified during the scoping period

Chapter 2 – Purpose and Need
Reasons for DOE action and the proposed objectives

Chapter 3 – Proposed Action and Alternatives
Description of the TA-18 ongoing missions and the project requirements to fulfill them; description of the alternatives; a summary comparison of the potential environmental impacts of the EIS alternatives; and the Preferred Alternative

Chapter 4 – Affected Environment
Aspects of the environment that could be affected by the EIS alternatives

Chapter 5 – Environmental Impacts
Analyses of the potential impacts of the EIS alternatives on the environment and a comparison to the projected environmental conditions that would be expected if no action were taken; includes a separate analysis of relocating the TA-18 security Category III/IV activities to alternative locations at LANL

Chapter 6 – Regulatory Requirements

Environmental, safety, and health regulations that would apply for this EIS's alternatives and the agencies consulted for their expertise

Chapters 7 – 11

A list of references; a glossary; an index; a list of preparers; and a list of agencies, organizations, and persons to whom copies of this EIS were sent

Volume II contains 10 appendices, 6 of which provide technical information in support of the environmental analyses presented in Volume I. The 10 appendices contain the following information: critical assembly descriptions; human health effects from normal operations; human health effects from facility accidents; human health effects from transportation; environmental justice; environmental impacts methodology; ecological resources; *Federal Register* notices; an overview of the public participation process; and the Contractor Disclosure Statement.

3.3.2.3 Construction Requirements

Table 3–5 shows the construction requirement parameters used for the environmental impact analysis.

Table 3–5 Construction Requirements under the TA-18 Upgrade Alternative

Requirement	*Quantity*
Electrical energy (megawatt hours)	378
Peak electrical demand (megawatts)	0.2
Concrete (cubic meters)	688
Steel (metric tons)	49
Fuel/gasoline (liters)	(a)
Water (liters)	5,800,000
Land (hectares)	0.2
Construction workers	
Total (during construction)	220
Peak	110
Construction time (months)	24

[a] Not provided. Considered to be part of construction costs; contractors to provide fuel/gasoline needed for their machinery.
Source: LANL 2001a.

3.3.3 LANL New Facility Alternative

This alternative would involve the relocation of TA-18 operational capabilities and materials associated with security Category I/II activities to new buildings northwest of the existing Plutonium Facility 4 in LANL's TA-55 and extension of the existing TA-55 PIDAS (LANL 2001a). The location of TA-55 within LANL is shown in Figure 4–1. The location of the proposed new buildings is shown in **Figure 3–4**. The site plan for the proposed buildings is shown in **Figure 3–5**. Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at TA-39 or remain at TA-18. The rest of the security Category III/IV activities would be relocated to a new structure at TA-55 or would remain at TA-18. The relocation of SHEBA and other security Category III/IV activities to new structures is discussed in Section 5.6.

3.3.3.1 Facilities

The new security Category I/II operations buildings would consist of above-grade structures that would house support operations and below-grade structures that would house criticality assembly areas and SNM vaults. The criticality assembly level would consist of criticality bays and SNM vaults that would be below-grade, with a minimum of 6 meters (20 feet) of cover consisting of rubble and earth. This level would consist of approximately 3,252 square meters (35,000 square feet) of floor space. Construction of the below-grade portions of the facility would consist of reinforced concrete. **Figure 3–6** shows the location of the critical assembly machines and SNM vaults at the critical assembly level. The control-room level would consist of the control rooms for the criticality bays and other support areas. The control-room level would be at grade and constructed of reinforced concrete. This level would consist of approximately 1,161 square meters (12,500 square feet) of floor space.

The new low-scatter bay would be a pre-engineered-type building with a 5-meter-deep (15-foot-deep) basement. The building would consist of approximately 604 square meters (6,500 square feet) of floor space. A PIDAS security fence would be constructed to surround the facility. Access to the facility would be through a Protected Area Access Control Building.

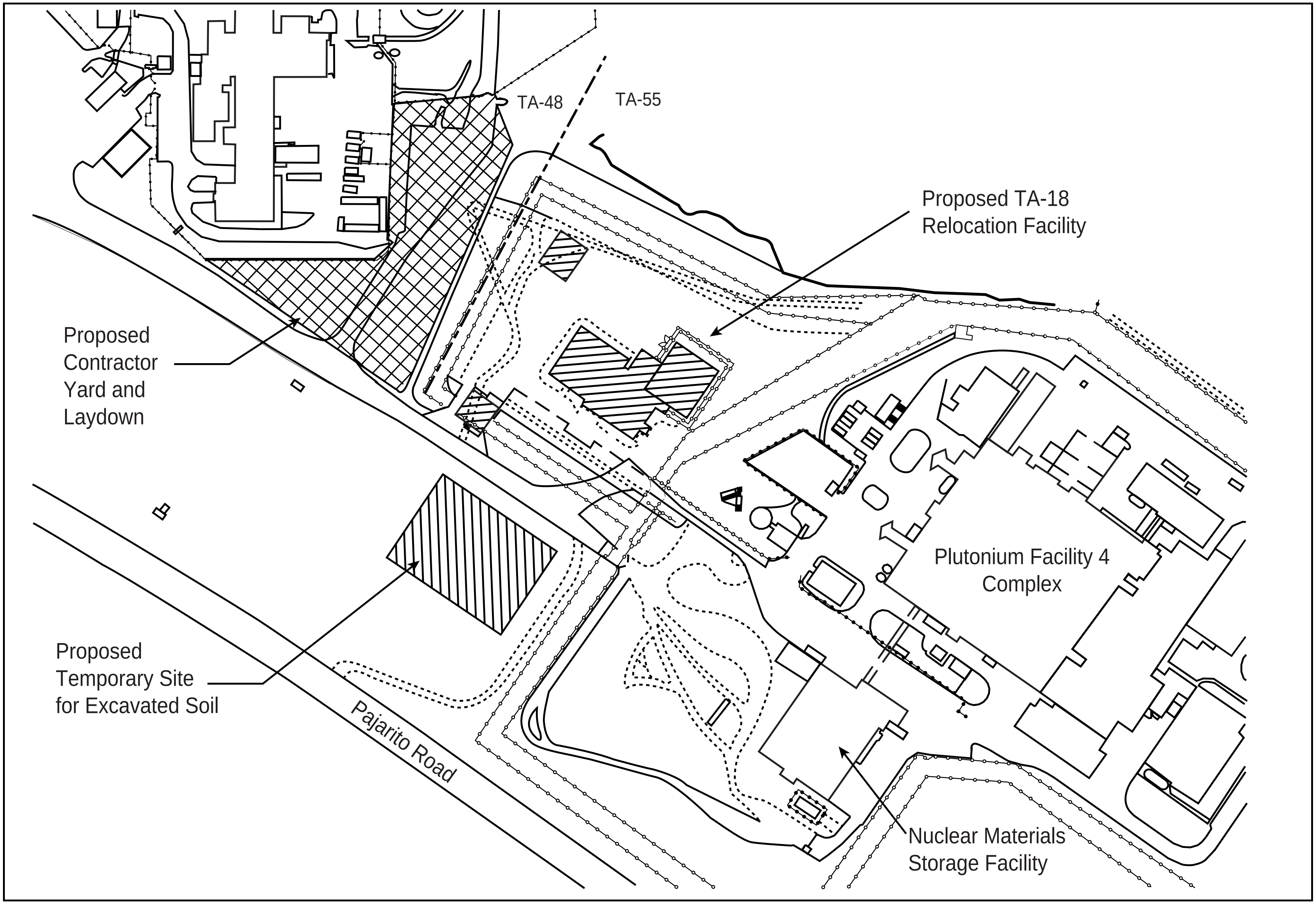


Figure 3–4 Location of the Proposed New Facility (LANL New Facility Alternative)

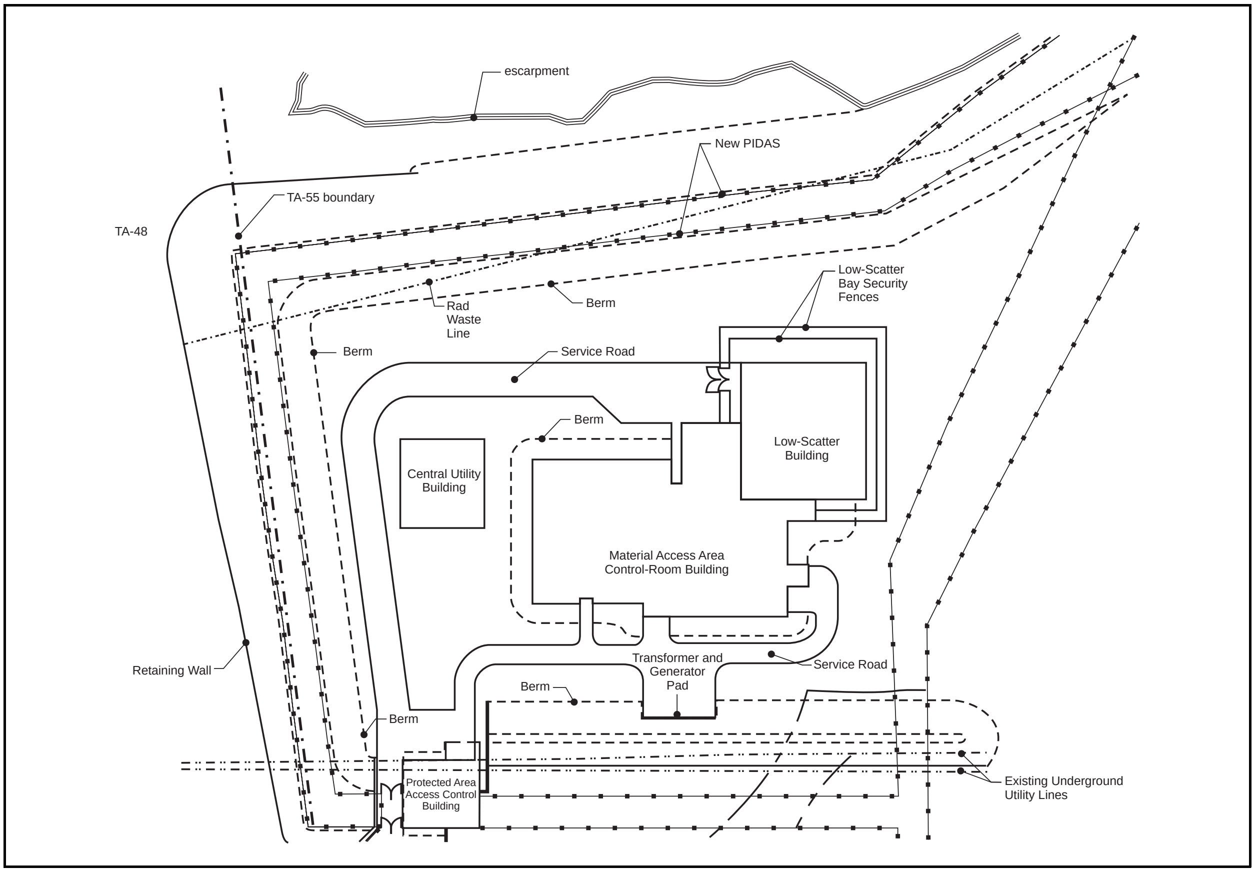


Figure 3–5 Site Plan for Proposed LANL Facility (LANL New Facility Alternative)

3.3.3.2 Annual Operations

The operational characteristics of the facilities under the LANL New Facility Alternative, common to all alternatives, are provided in Section 3.2.

3.3.3.3 Construction Requirements

Table 3–6 shows the construction requirement parameters used in the environmental impact analysis.

Table 3–6 Construction Requirements under the LANL New Facility Alternative

Requirement	*Quantity*
Electrical energy (megawatt hours)	170
Peak electrical demand (megawatts)	0.13
Concrete (cubic meters)	15,324
Steel (metric tons)	842
Fuel/gasoline (liters)	(a)
Water (liters)	22,700,000
Land (hectares)	1.82
Construction workers	
Total (during construction)	400
Peak	300
Construction time (months)	16

[a] Not provided. Considered to be part of construction costs; contractors to provide fuel/gasoline needed for their machinery.
Source: LANL 2001a.

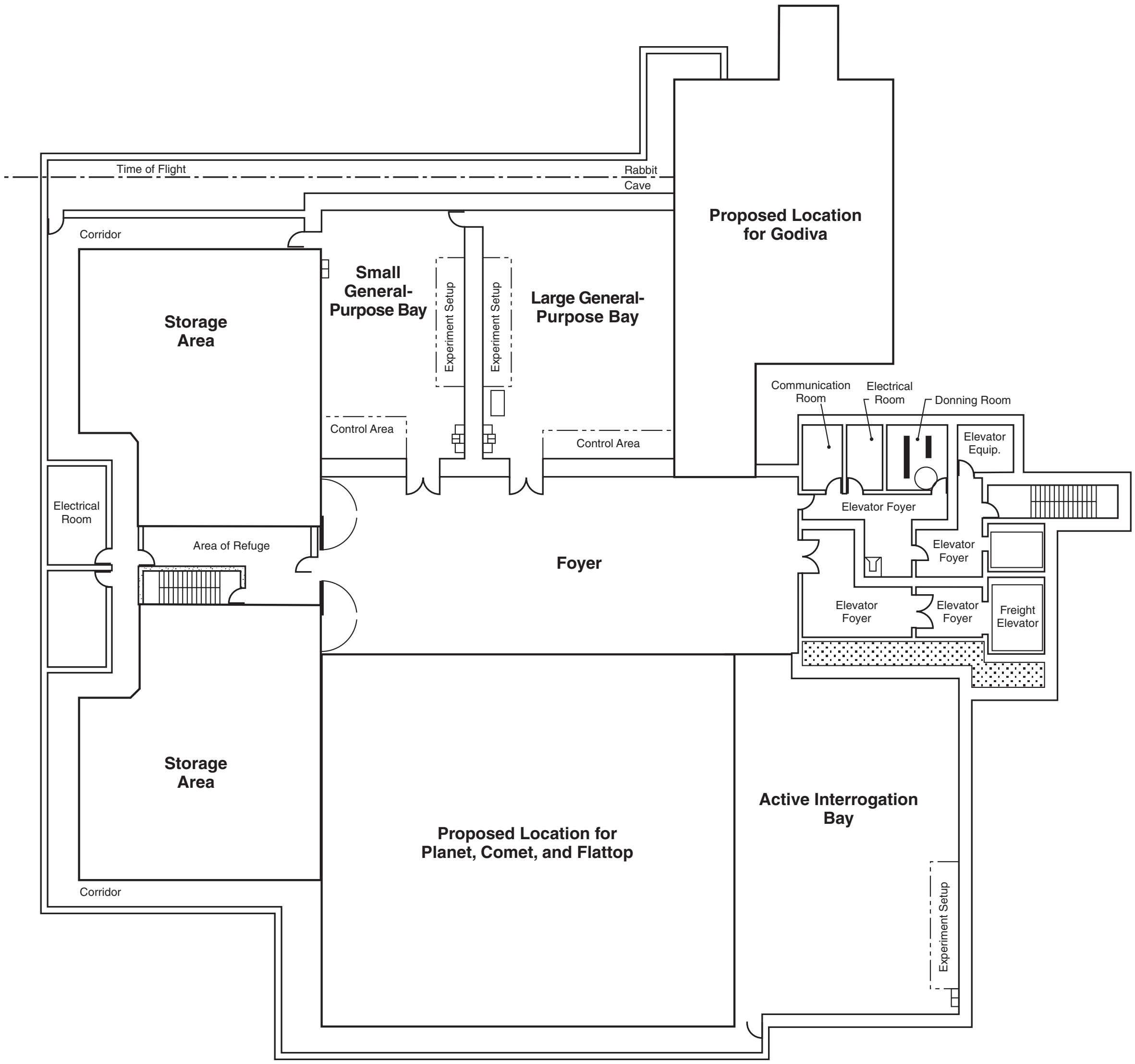


Figure 3–6 Location of Critical Assembly Machines and SNM Vaults (LANL New Facility Alternative)

3.3.4 SNL/NM Alternative

This alternative would involve the housing of the TA-18 operational capabilities and materials associated with security Category I/II activities within TA-V[1] at SNL/NM. Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at LANL's TA-39 or remain at TA-18. The rest of the security Category III/IV activities would remain at TA-18. The relocation of SHEBA and other security Category III/IV activities to new structures at LANL is discussed in Section 5.6.

[1] *Technical areas at SNL/NM are designated using roman numerals rather than the arabic numerals used at LANL.*

3.3.4.1 Facilities

To support the relocation of TA-18 operational capabilities and materials associated with security Category I/II activities, it is proposed to construct a new underground building and modify or renovate 10 existing aboveground buildings. All construction and renovation activities would be within SNL/NM's TA-V area (SNL/NM 2001a). The locations of the proposed new facility and existing facilities are shown in **Figure 3–7**.

The overall size of the new underground facility would be approximately 3,286 square meters (35,370 square feet); the areas proposed to be renovated in all 10 existing buildings would total approximately 5,007 square meters (53,895 square feet). Proposed new underground construction would include nuclear material storage vaults, the larger portion of the critical assembly facility, the active interrogation facility, and a general-purpose nuclear material work bay. **Figure 3–8** shows a schematic of the underground facility. Structures that would be located in the aboveground renovations would include emergency response staging and maintenance, electronics, and a machine shop and instrumentation laboratory in the Hot Cell Facility (Building 6580); the critical assembly control rooms and warehouse in the Auxiliary Hot Cell (Building 6597); a low-scatter facility in the chapel (Building 6596); waste management storage areas in the warehouse (Building 6595); and explosive storage and radioactive-source storage areas in the Reactor Maintenance Facility (Building 6593). An existing shop (Building 6591) would also be used as a staff shop (see Figure 3-7).

3.3.4.2 Annual Operations

The operational characteristics of the facilities under the SNL/NM Alternative, common to all alternatives, are provided in Section 3.2.

3.3.4.3 Construction Requirements

Table 3–7 shows the construction requirement parameters used in this environmental impact analysis.

Table 3–7 Construction Requirements under the SNL/NM Alternative

Requirement	***Quantity***
Electrical energy (megawatt hours)	170
Peak electrical demand (megawatts)	0.1
Concrete (cubic meters)	15,324
Steel (metric tons)	842
Fuel/gasoline (liters)	(a)
Water (liters)	22,700,000
Land (hectares)	1.82
Construction workers	
Total (during construction)	400
Peak	300
Construction time (months)	16

[a] Not provided. Considered to be part of construction costs; contractors to provide fuel/gasoline needed for their machinery.
Source: SNL/NM 2001a.

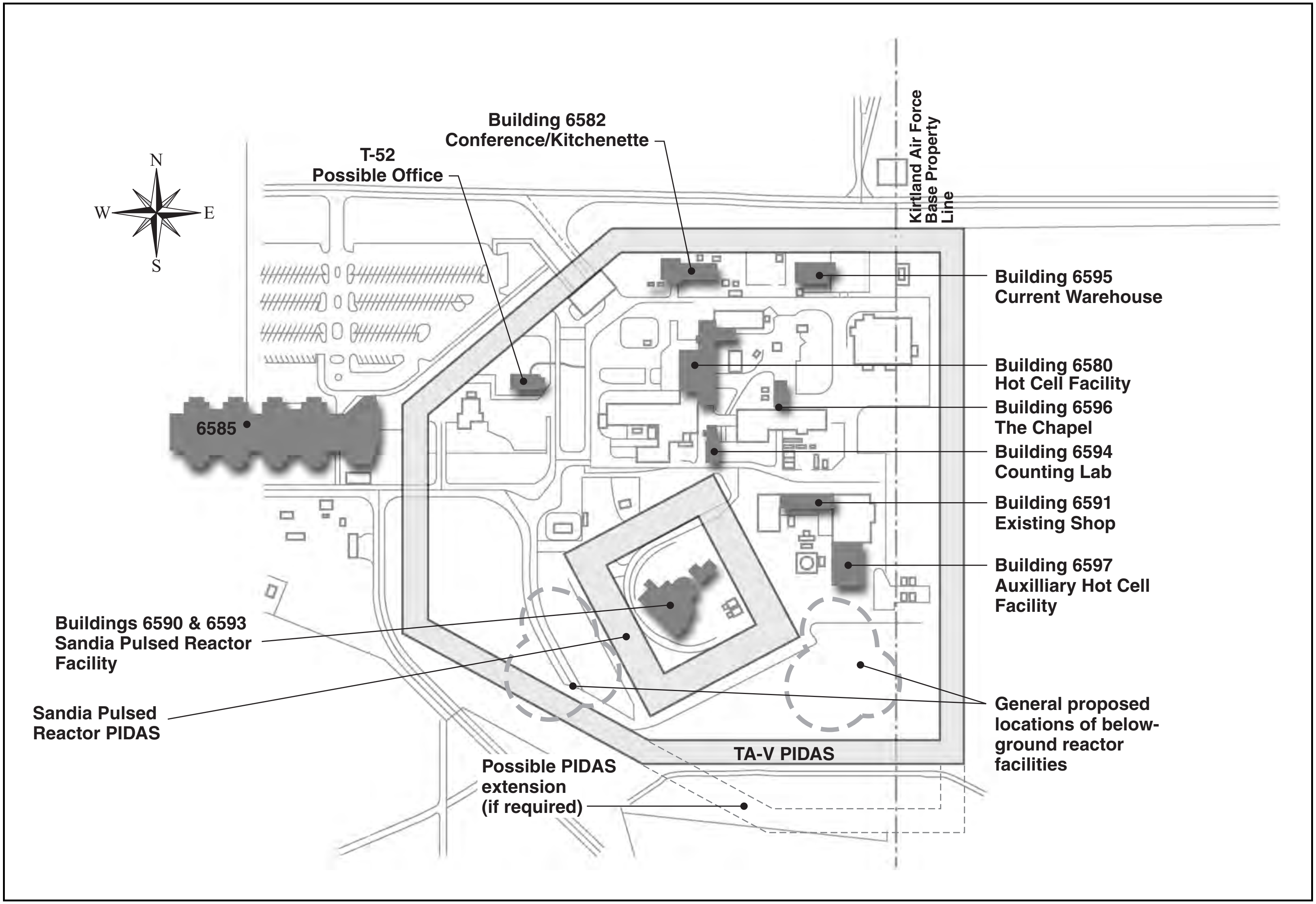


Figure 3–7 Proposed New SNL/NM Facility and Existing Facilities (SNL/NM Alternative)

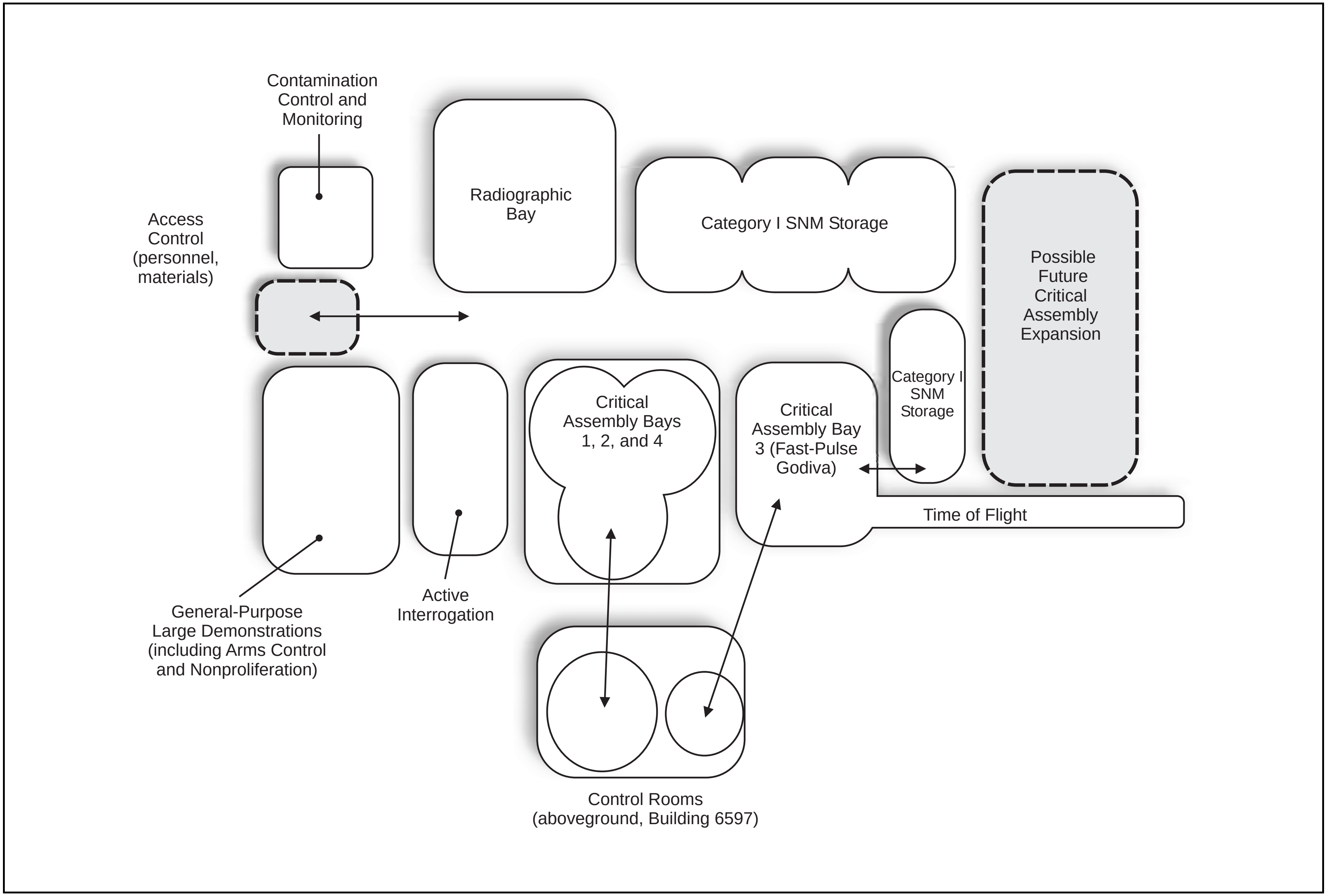


Figure 3–8 Schematic of the Underground Facility (SNL/NM Alternative)

3.3.5 NTS Alternative

This alternative would involve housing the TA-18 operational capabilities and materials associated with security Category I/II activities in and around the existing DAF at NTS. For this purpose, DAF would be modified internally to accommodate the critical assembly machines, control rooms, and SNM vaults, and two new buildings would be constructed external to the DAF security perimeter. The two new buildings would be a "low-scatter" facility to house emergency response activities with minimal reflection and a new administration building to accommodate a DAF Central Command Station and increased staffing associated with the TA-18 security Category I/II missions (NTS 2001). Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at LANL's TA-39 or remain at TA-18. The rest of the security Category III/IV activities would remain at TA-18. The relocation of SHEBA and other security Category III/IV activities to new structures at LANL is discussed in Section 5.6.

3.3.5.1 Facilities

Device Assembly Facility

DAF is a 9,290-square-meter (100,000-square-foot) nuclear explosive facility within a 12-hectare (29-acre) high-security area, located in Area 6 of DOE's NTS (see **Figure 3–9**). Construction on DAF began in the mid-1980s, when nuclear weapons testing was still in progress. DAF's original purpose was to consolidate all nuclear explosive assembly functions and to provide safe structures for high-explosive and nuclear explosive assembly operations, as well as a state-of-the-art safeguards and security environment.

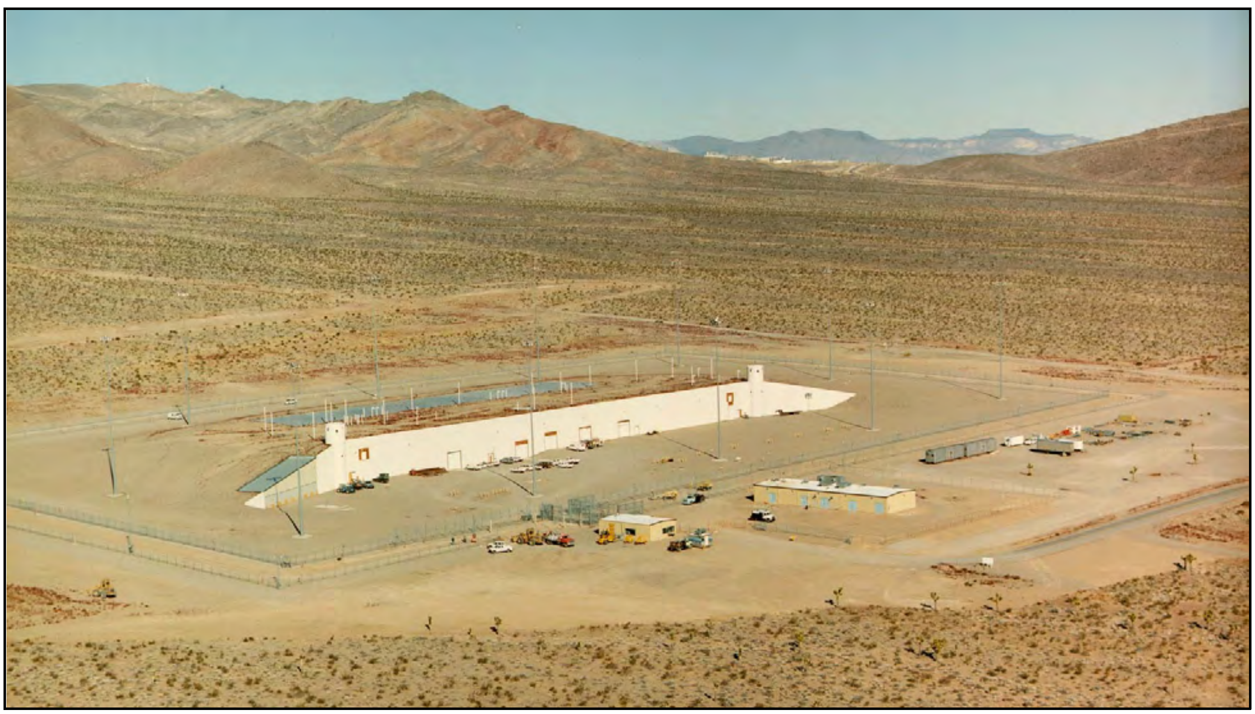


Figure 3–9 DAF at NTS

DAF has five assembly cells, four high bays, three assembly bays, two radiography bays, five staging bays, a component testing laboratory, two shipping and receiving buildings, two decontamination facilities, three small vaults, an administration building, alarm stations, an entry guard station, and a mechanical and electrical support building (see **Figure 3–10**).

The main facility is covered with a minimum of 1.5 meters (5 feet) of earth. The major operating facilities, assembly cells and high bays, radiography bays, and shipping and receiving building have bridge cranes. Each assembly cell is designed and tested to undergo an explosion from a maximum high-explosive device without injury to personnel in an adjacent blast-protected area outside of the cell. Gravel covers are designed to minimize release of nuclear material in the unlikely event of an accidental explosion.

One face of DAF is exposed and opens onto the area enclosed within a PIDAS security fence. DAF has a comprehensive security system designed into the structure.

The TA-18 security Category I/II operational activities would occur in the west side of Building 400. The building east of Building 400 is currently nonoperational and kept in "ready-reserve" status. The current missions in this building would be relocated to the east side of the building. **Figures 3‑11** and **3–12** show the proposed changes to accommodate the TA-18 activities.

The Building 370 corridor would remain in its present configuration with no equipment located within the corridor. The corridor is an unoccupied area, with administratively controlled access during normal operations.

A DAF Central Control Station would be placed in Building 400, allowing a readout of building status; fire and radiation alarm annunciation; weather reports on lightning; intercom and closed-circuit television control; and status of the individual heating, ventilating, and air conditioning systems.

Modifications inside DAF would include:

- Local modifications to internal walls, floors, and ceilings
- Local additions of bulk and penetration-shielding materials
- Local demolition of fire-suppression and other water systems
- Removal of polar cranes from assembly cells
- Raceway additions connecting the critical assemblies to their control rooms and power supplies
- Implementation of a DAF Central Control Station
- A new line-of-sight corridor internal to DAF

Buildings 302, 310, 332, and 352 would be used to house the critical assembly machines and associated control areas. Buildings 492 and 494 would be used for SNM storage.

New Low-Scatter Building

Because DAF is designed for blast protection, the buildings are constructed using massive concrete and steel surrounded by earthen fill. This is not compatible with one TA-18 activity that requires low reflectance from the surrounding walls, ceiling, and floor. The only acceptable way to meet this requirement would be to place this activity outside of DAF in a new "thin-skin," or "low-scatter," building. This low-scatter building would consist of a thin metal building and basement to prevent floor and wall radiation scatter. The low-scatter building would be placed in a location outside the DAF PIDAS.

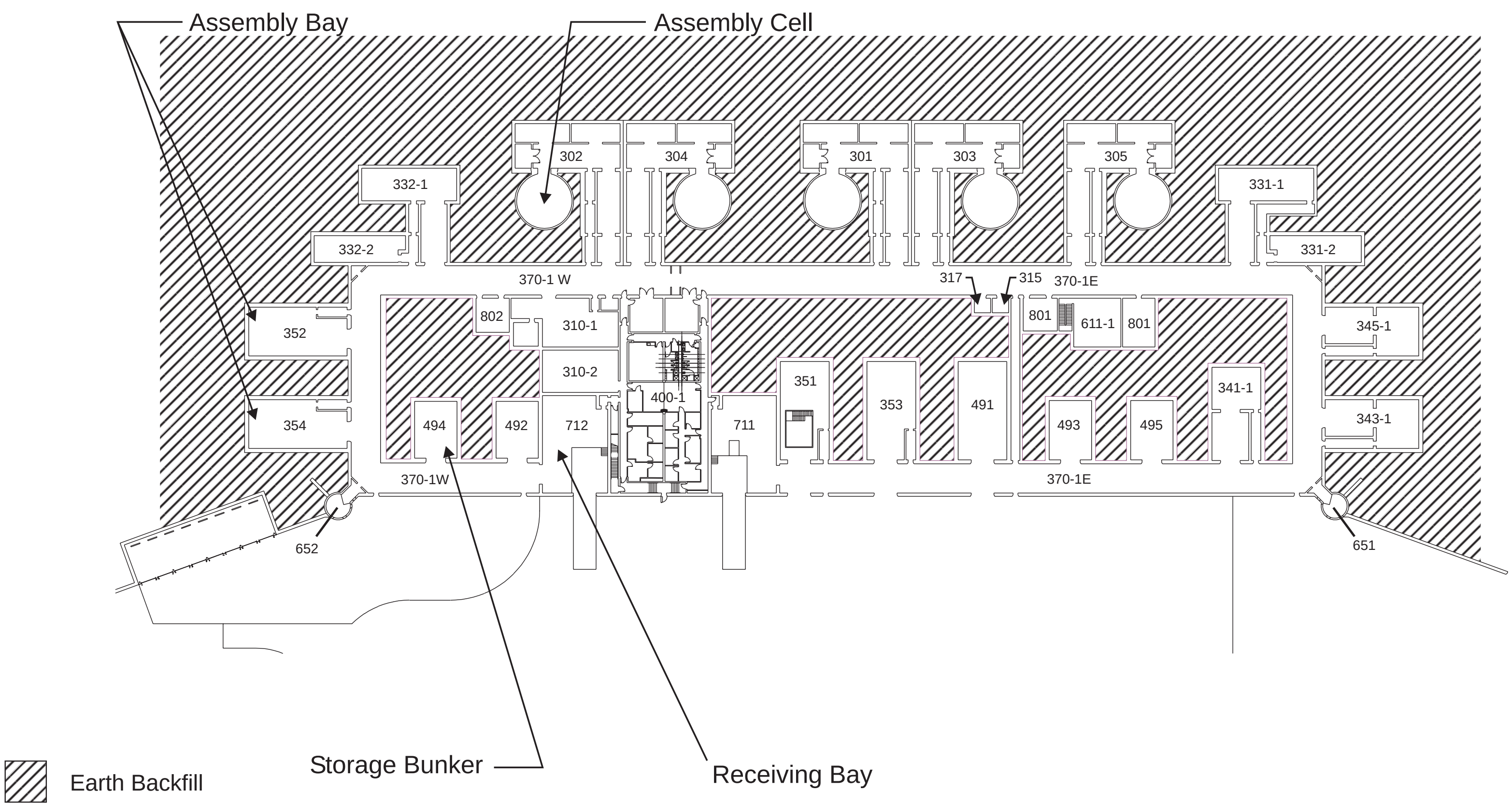


Figure 3–10 DAF Floor Plan

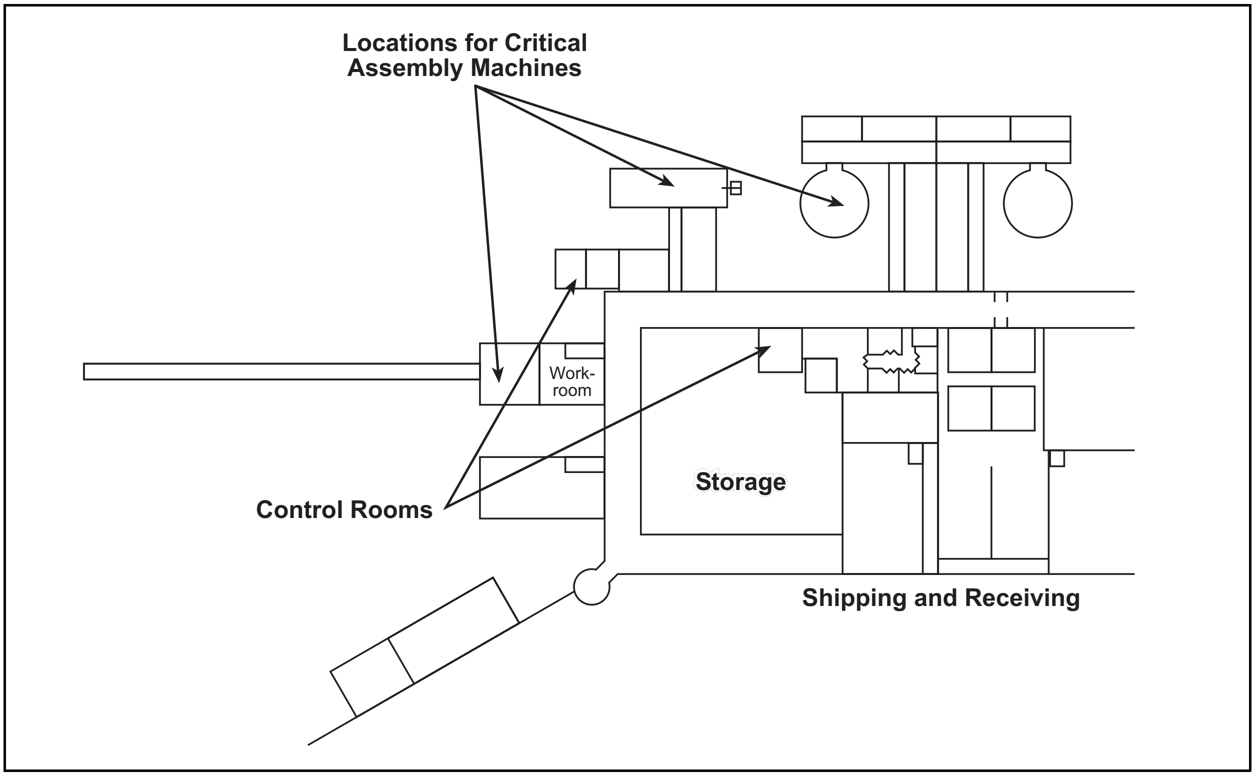


Figure 3–11 DAF Critical Assembly Layout

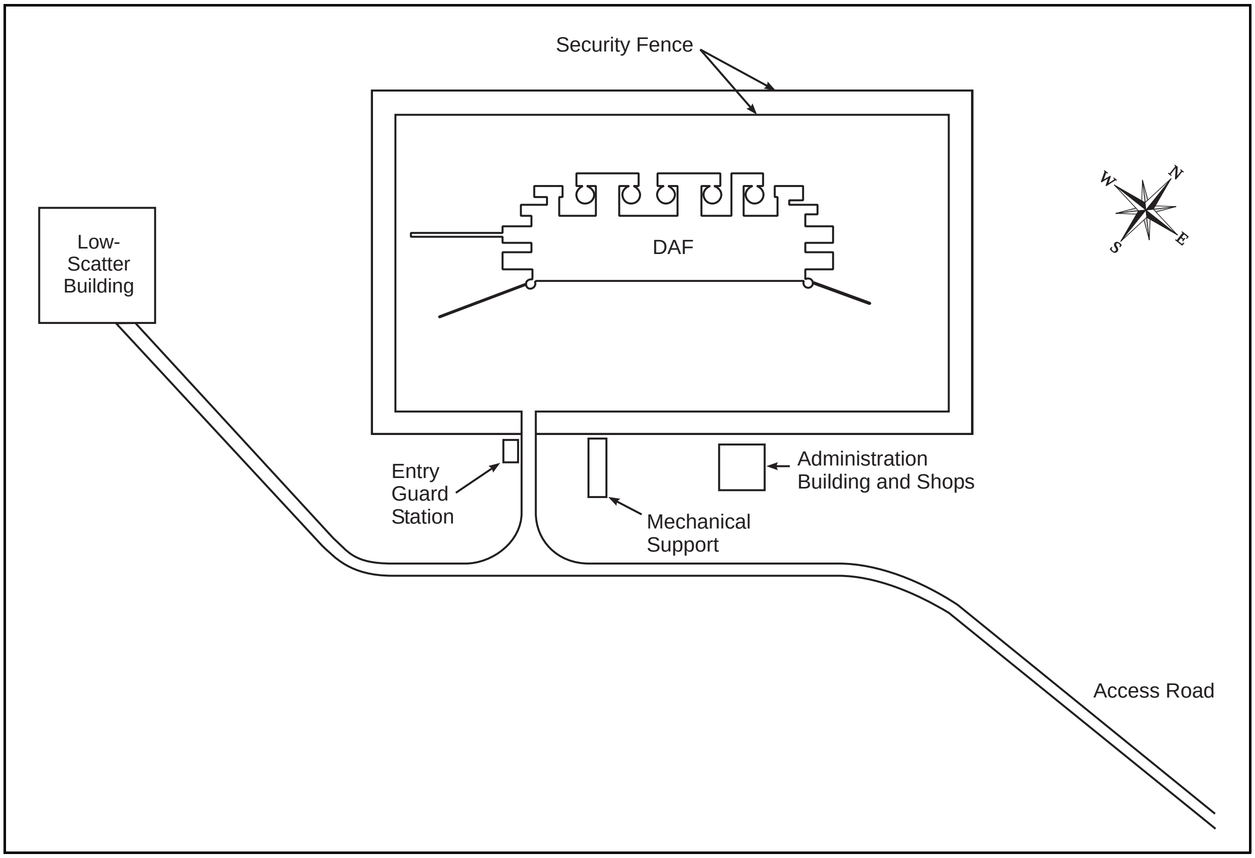


Figure 3–12 DAF Layout Site Vicinity

The TA-18 radiography function would be accommodated in the existing DAF radiography building.

New Administration Building

The personnel currently in Building 400 would be displaced to allow room for the DAF Central Control Station, Radiation Control Technician work area, Hot Work Laboratory, Document Control Center, and a screening entrance to the Material Accountability Area boundary. This displacement of personnel would require a new Administrative Building outside the PIDAS. The new 1,115-square-meter (12,000-square-foot) facility would house personnel, provide conference facilities, allow space for storage of materials, and house emergency response equipment.

3.3.5.2 Annual Operations

The operational characteristics of the facilities under the NTS Alternative, common to all alternatives, are provided in Section 3.2.

3.3.5.3 Construction Requirements

Table 3–8 shows the construction requirement parameters used in the environmental impacts analysis.

Table 3–8 Construction Requirements under the NTS Alternative

Requirement	*Quantity*
Electrical energy (megawatt hours)	16 [a]
Peak electrical demand (megawatts)	0.08
Concrete (cubic meters)	288
Steel (metric tons)	(b)
Fuel/gasoline (liters)	(b)
Water (liters)	3,980,000
Land (hectares)	3.64
Construction workers	
Total (during construction)	45
Peak	60
Construction time (months)	9

a Electric usage outside the DAF building.

b Not provided. Considered to be part of construction costs; contractors to provide steel for the construction and fuel/gasoline needed for their machinery.

Source: NTS 2001.

3.3.6 ANL-W Alternative

This alternative would involve the housing of TA-18 operational capabilities and materials associated with security Category I/II activities in buildings located at ANL-W. The facilities proposed for the relocation of security Category I/II activities are: FMF, with a proposed addition; the Zero Power Physics Reactor (ZPPR) facility; the Experimental Breeder Reactor II (EBR-II) containment and power plant; the Transient Reactor Test (TREAT) facility; and a new General-Purpose Experimental Building (GPEB) (ANL-W 2001). The site plan is shown in **Figure 3–13.** Under this alternative, a portion of the security Category III/IV activities (the SHEBA activities) would either be relocated to a new structure at LANL's TA-39 or remain at TA-18. The rest of the security Category III/IV activities would remain at TA-18. The relocation of SHEBA and other security Category III/IV activities to new structures at LANL is discussed in Section 5.6.

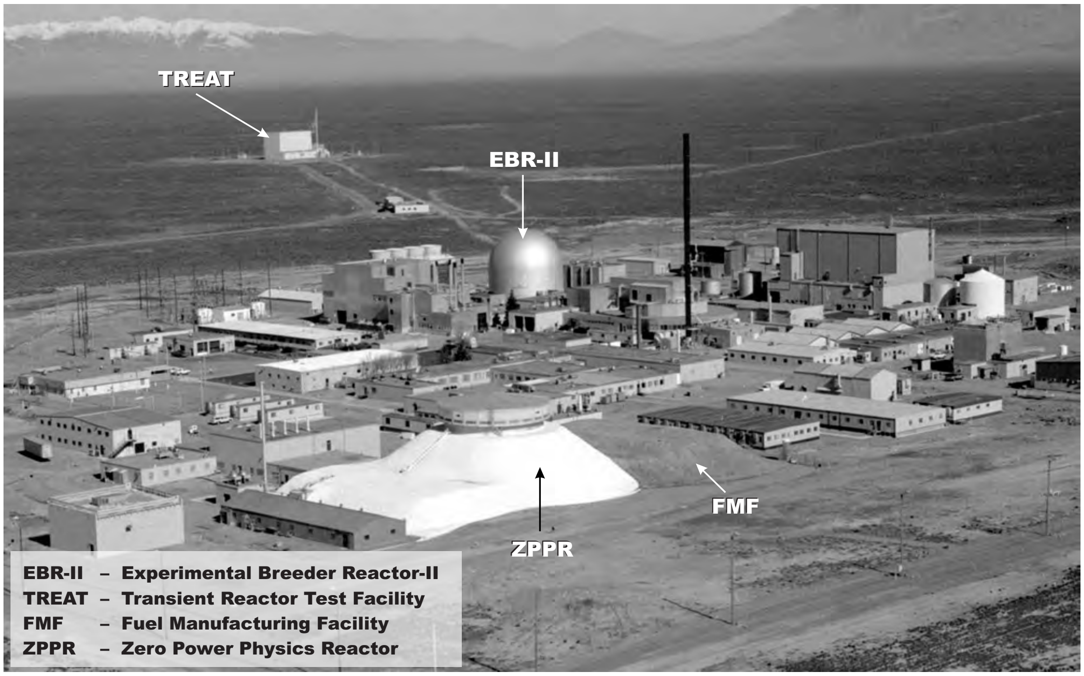


Figure 3–13 ANL-W Site

One critical assembly machine would be housed in the ZPPR cell with the control room collocated with the ZPPR control room. The control rooms would be located in the ZPPR support wing (Building 774), inside the protected area. Three other critical assemblies would be located in a new addition to FMF (Building 704). Control rooms would be located in the basement of the ZPPR support wing (Building 774), which is outside of the protected area (see **Figure 3–14**).

The EBR-II containment building would be used for radiography equipment. The truck lock located in the EBR-II power plant would be used for the emergency response staging area.

The low-scatter facility would be located on either the turbine floor of the EBR-II Power Plant (Building 768) or at the north end of the TREAT Reactor Building (Building 720).

Storage vault space requirements for security Category IB SNM would be provided in four different vaults within the protected area. Two of the vaults currently exist, while the other two would be constructed along with the new additions.

3.3.6.1 Facilities

Fuel Manufacturing Facility

FMF (Building 704) is located adjacent to the ZPPR facility (see **Figure 3–15**) and is covered with an earthen mound. FMF was used to manufacture fuel for EBR-II. The facility was completed in 1986 and was oversized for the EBR-II mission. The building includes a large SNM vault, an induction furnace, and gloveboxes and hoods, as well as other temporary experimental setups.

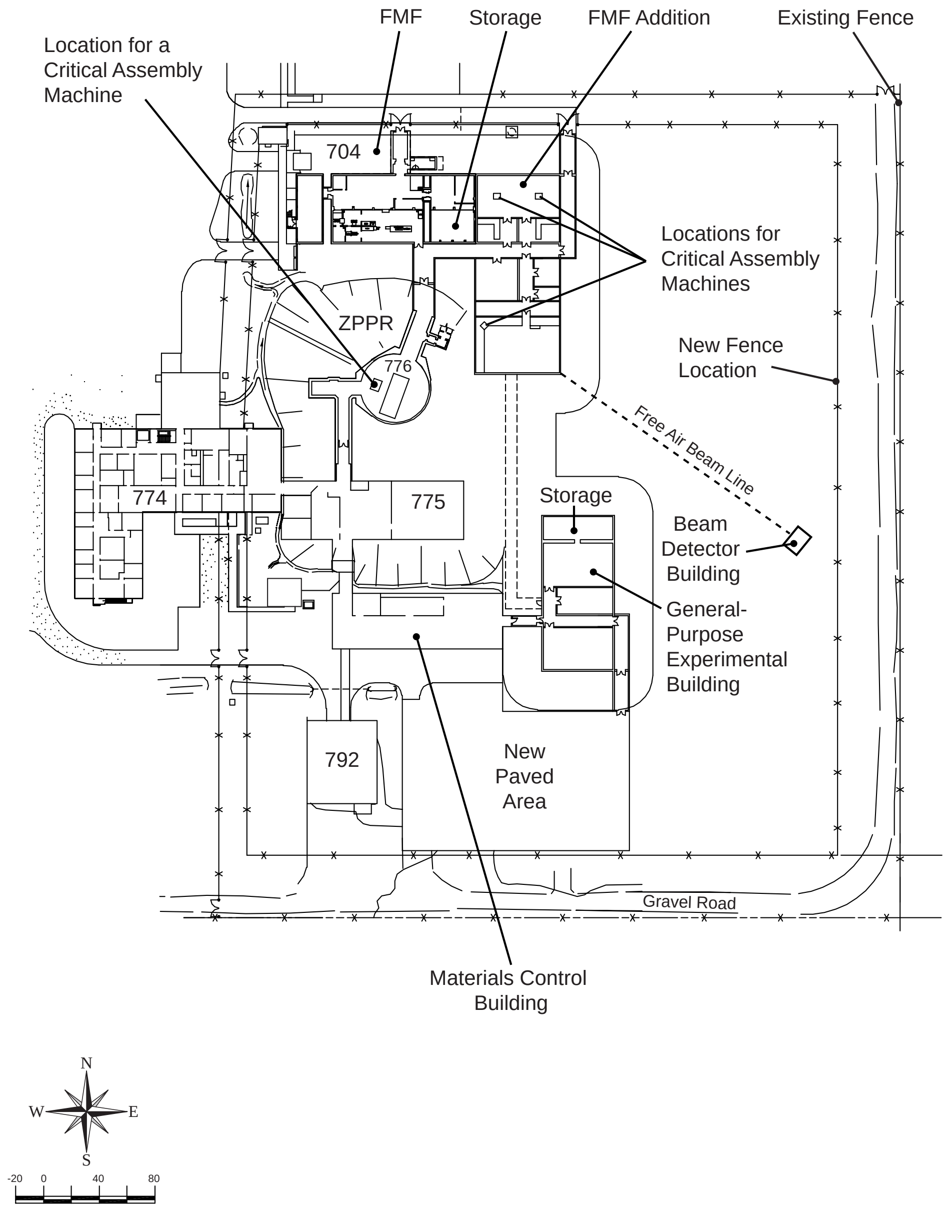


Figure 3–14 Proposed Relocation Layout (ANL-W Alternative)

Zero Power Physics Reactor

One critical assembly machine would be located in the reactor cell room of ZPPR (Building 776). It would share floor space in the reactor cell room with the existing ZPPR matrix. The material and equipment staging area for the machine would be located in Room 144 of Building 776, which is an alcove to the west of the reactor cell room. Space for instrumentation would be located in the workroom in Building 775.

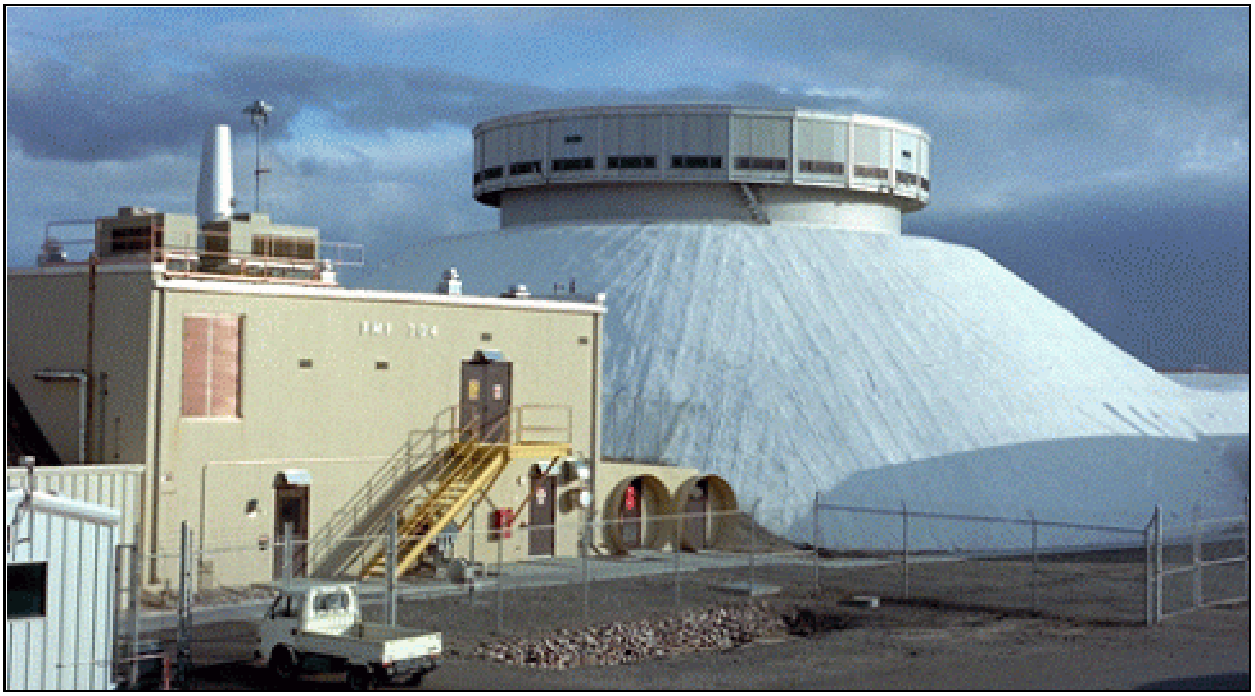


Figure 3–15 FMF and ZPPR Facilities

The ZPPR facility was built to allow the mock-up of full-sized breeder reactor cores using critical assemblies with full plutonium loadings. The facility includes a refined "Gravel Gertie" building, a type of construction originally designed for handling nuclear weapons. The principal experimental area has a very thick foundation and thick concrete walls covered with an earthen mound and a sand/gravel/high-efficiency particulate air filter roof. In addition to being explosion-resistant, the facility was designed to safely contain a fire involving a full breeder reactor core loaded with more than 2.7 metric tons (3 tons) of plutonium.

The ZPPR vault is located in Building 775, which is just south of the Building 776 ZPPR reactor cell within the protected area. ZPPR is currently in a nonoperational standby status. The ZPPR fuel inventory remains on the ANL-W site, and the ZPPR vault/workroom remains operational to support nuclear materials storage in the ZPPR vault. The stainless steel matrix and the support structure that make up the core, i.e., the critical assembly structure, remain in the reactor cell and are essentially uncontaminated and inactivated.

Experimental Breeder Reactor-II

The EBR-II containment building (Building 767) would be used for locating radiography equipment. The EBR-II facility is shown in **Figure 3–16**.

Transient Reactor Test Facility

Two locations have been identified that would be suitable for the low-scatter facility. One location is on the third floor of the power plant building, and the second is in the north end of the TREAT reactor building (Building 720). The TREAT facility is shown in **Figure 3–17**. A removable, elevated catwalk would need to be constructed for this purpose.

Figure 3–16 EBR-II Facility

Figure 3–17 TREAT Facility

TREAT is an air-cooled, thermal heterogeneous test facility designed to evaluate reactor fuel and structural materials under conditions simulating various types of transient overpower and undercooling situations in a nuclear reactor. The TREAT complex comprises reactor and control buildings located within a mile to the northwest of the main ANL-W protected area at the ANL-W site. The TREAT facility is located within its own security Category II protected area. To better accommodate program activities temporarily performed in the building, the TREAT protected area is currently administered as security Category III, but authorization for security Category II operation remains.

New General-Purpose Experimental Building

To support detector development, research and development, training, and technology demonstrations, a new security Category I GPEB would be constructed. GPEB would be located next to the Materials Control Building (Building 784), with a new paved area to support material transportation vehicles (see Figure 3–14). Additional vault space for large items would be provided in GPEB.

New FMF Addition

An addition to FMF would be constructed to locate three of the critical assemblies (see Figure 3–14). The FMF addition would use the same beamed structural design as FMF. The facility structure, as well as the ventilation, would constitute the confinement system of the FMF addition.

The FMF addition would have exterior dimensions of 44 meters (145 feet) long (north-south) and 19 meters (62 feet) wide (east-west). The facility would be accessed by a new access tunnel starting from the ZPPR reactor cell and traveling to the west side of the addition. An escape tunnel would be located on the east side of the facility leading to a grated area. Security doors would be installed in the new tunnel extension from ZPPR and the escape tunnel.

3.3.6.2 Annual Operations

The operational characteristics of the facilities under the ANL-W Alternative, common to all alternatives, are provided in Section 3.2.

3.3.6.3 Construction Requirements

Table 3–9 shows the construction requirement parameters used in the environmental impacts analysis.

3.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

3.4.1 Discontinue TA-18 Missions

As explained in Chapter 2, the operations conducted at TA-18 are vital for DOE's mission requirements and must be maintained. This determination is consistent with independent reviews made by the Defense Nuclear Facilities Safety Board. In separate 1993 and 1997 studies of the TA-18 missions (DNFSB 1993, DNFSB 1997), the Defense Nuclear Facilities Safety Board recommended that DOE continue to maintain the capability to support the only remaining criticality safety program in the Nation. Few or none of DOE's nuclear programs could ensure their safe execution without the continued training, expertise, and calibration experiments that are available at a general-purpose criticality experiments facility. This alternative did not meet DOE's need for action and was not further analyzed in this EIS.

Table 3–9 Construction Requirements under the ANL-W Alternative

Requirement	*Quantity*
Electrical energy (megawatt hours)	26.2
Peak electrical demand (megawatts)	0.033
Concrete (cubic meters)	7,301
Steel (metric tons)	675
Fuel/gasoline (liters)	(a)
Water (liters)	97,300
Land (hectares)	0.62
Construction workers	
Total (during construction)	104
Peak	120
Construction time (months)	24

[a] Considered to be part of construction costs; contractors to provide fuel/gasoline needed for their machinery.
Source: ANL-W 2001.

3.4.2 Alternative Sites

As explained in Section 3.2.2, during the initial screening process, all DOE sites were considered for the relocation of TA-18 operational capabilities and materials. The DOE sites that did not pass the screening criteria were Rocky Flats, Hanford, the Idaho National Engineering and Environmental Laboratory, and Brookhaven National Laboratory. In addition to the DOE sites, possible relocation to Department of Defense installations was considered. However, there were serious concerns regarding long-term mission compatibility and security Category I requirements; therefore, Department of Defense sites were removed from further consideration for this EIS.

All DOE sites that passed the initial screening criteria were sent a request for additional site information. Five sites—Pantex (Amarillo, Texas), the Y-12 Plant (Oak Ridge, Tennessee), Oak Ridge National Laboratory (Oak Ridge, Tennessee), the Savannah River Site (Aiken, South Carolina), and Lawrence Livermore National Laboratory (Livermore, California)—were eliminated from further consideration because they did not meet the minimum site selection criteria requirements.

The potential use of the existing Nuclear Materials Storage Facility (NMSF) at TA-55 at LANL was evaluated for partial fulfillment of the TA-18 Relocation Project requirements. The evaluation included consideration of the use of NMSF for three critical assembly machines (excluding Godiva) and existing tunnels or other NMSF spaces for nuclear material storage. It was concluded that the TA-18 missions would not fit well into the NMSF and its use would still require a new building to be constructed. Such a proposal would require increased capital and operational costs.

3.5 COMPARISON OF ALTERNATIVES

3.5.1 Introduction

To aid the reader in understanding the differences among the various alternatives, this section presents a summary comparison of the potential environmental impacts associated with the alternatives for the relocation of the TA-18 operational capabilities and materials. The comparisons concentrate on those resources with the greatest potential to be impacted.

The information in this section is based on the descriptions of each alternative presented earlier in this chapter and the potential environmental consequences (presented in Chapter 5). Because the potential environmental impacts associated with each of the alternatives can be described in terms of *construction impacts* and *operations impacts*, the potential impacts are compared in those two areas. **Table 3–10** at the end of this chapter provides quantitative information that supports the text below. Table 3-10 also includes the environmental impacts associated with the potential relocation of the SHEBA activities and other security Category III/IV activities to new structures at LANL (see the last two columns of the table). These impacts should be considered in conjunction with the impacts involving the relocation of the TA-18 security Category I/II activities if SHEBA and other security Category III/IV activities do not remain at TA-18.

3.5.2 Construction Impacts

No Action Alternative—Under the No Action Alternative, as described in Section 3.3.1, there would be no new construction or upgrades. Accordingly, there would be no potential environmental impacts resulting from construction for this alternative.

TA-18 Upgrade Alternative—Under the TA-18 Upgrade Alternative, as described in Section 3.3.2, there would be minor construction impacts associated with upgrading the existing infrastructure and security at TA-18 to bring them into compliance with new and more stringent safety, security, and environmental standards. While most of the construction impacts would involve internal modifications to existing facilities, several new support facilities would be constructed, disturbing approximately 0.2 hectares (0.5 acres) of previously cleared land. The existing infrastructure would adequately support construction activities. Construction activities would result in potential temporary increases in air quality impacts, but these would be below ambient air quality standards. Construction activities would likely result in no or minor impacts on water, visual resources, biotic resources (including threatened and endangered species), geology and soils, or cultural and paleontological resources. The socioeconomic impacts associated with construction would not cause any major changes to employment, housing, or public finance in the socioeconomic region of influence. Waste generated during construction would be adequately managed by the existing LANL waste management infrastructure.

LANL New Facility Alternative—The construction of new security Category I/II buildings at LANL's TA-55, as described in Section 3.3.3, would disturb approximately 1.8 hectares (4.5 acres) of land, but would not change the area's current land-use designation. At TA-55, the construction activities would not change the current land-use designation. The existing infrastructure would adequately support construction activities. Construction activities would result in temporary increases in air quality impacts, but would be below ambient air quality standards, except for short-term concentrations of total suspended particulates at TA-55. Construction activities would not significantly impact water, visual resources, biotic resources (including threatened and endangered species), geology and soils, or cultural and paleontological resources. The socioeconomic impacts associated with construction would not cause any major changes to employment, housing, or public finance in the socioeconomic region of influence. Waste generated during construction would be adequately managed by the existing LANL waste management infrastructure.

SNL/NM Alternative—The relocation of the TA-18 capabilities and materials associated with security Category I/II activities to SNL/NM, as described in Section 3.3.4, would use 10 existing facilities, while also constructing a new, underground facility at TA-V. Approximately 1.8 hectares (4.5 acres) of land would be disturbed during construction of the new underground facility. The existing infrastructure would adequately support construction activities. Because the area was disturbed during previous construction activities at TA-V, further land disturbance is not expected to result in significant impacts on air, water, visual resources, biotic resources (including threatened and endangered species), geology and soils, or cultural and paleontological resources. The TA-18 operations would not change the area's current land-use designation. The socioeconomic impacts associated with construction would not cause any major changes to employment, housing, or public finance in the socioeconomic region of influence. Waste generated during construction would be adequately managed by the existing SNL/NM waste management infrastructure.

NTS Alternative— The relocation of the TA-18 capabilities and materials associated with security Category I/II activities to NTS, as described in Section 3.3.5, would entail upgrading DAF and constructing a new low-scatter building adjacent to DAF, as well as a new administration building. Approximately 0.7 hectares (1.7 acres) of land would be disturbed. Because NTS is such a large, remote site, and because the area was disturbed previously during construction activities associated with DAF, further land disturbance would likely result in no or minor impacts on air, water, visual resources, biotic resources (including threatened and endangered species), geology and soils, or cultural and paleontological resources. The TA-18 operations would not change the area's current land-use designation. The socioeconomic impacts associated with construction would not cause any major changes to employment, housing, or public finance in the socioeconomic region of influence. Waste generated during construction would be adequately managed by the existing NTS waste management infrastructure.

ANL-West Alternative—The relocation of the TA-18 operational capabilities and materials associated with security Category I/II activities to ANL-W, as described in Section 3.3.6, would entail the use of existing buildings and the construction of a new security Category I experimental building, an addition to FMF, and a tunnel to the existing ZPPR building. Approximately 0.6 hectares (1.5 acres) of land would be disturbed during construction activities. The existing infrastructure would adequately support construction activities. Because the area was disturbed during previous construction activities, further land disturbance would likely result in no or minor impacts on air, water, visual resources, biotic resources (including threatened and endangered species), geology and soils, or cultural and paleontological resources. The TA-18 operations would not change the area's current land-use designation. The socioeconomic impacts associated with construction would not cause any major changes to employment, housing, or public finance in the socioeconomic region of influence. Waste generated during construction would be adequately managed by the existing ANL-W waste management infrastructure.

3.5.3 Operations Impacts

TA-18 capabilities and materials relocated to any of the alternative sites would use similar facilities, procedures, resources, and numbers of workers during operations. As such, similar infrastructure support would be needed, similar emissions and waste would be produced, and similar impacts on workers would occur. For each alternative, the proposed construction or modification of buildings, structures, and infrastructure is slightly different, as is the environmental setting. These site differences would lead to some differences in environmental impacts based on the same operations. For most environmental areas of concern, however, these differences would be minor. It is not expected that there would be any perceivable operations impact differences among the alternatives on air, water, visual resources, biotic resources (including threatened and endangered species), geology and soils, cultural and paleontological resources, power usage, socioeconomics, or worker risks. Additionally, all alternatives have adequate existing waste management facilities to treat, store, and/or dispose of waste that would be generated by these operations. For all alternative sites, all impacts would be within regulated limits and would comply with Federal, state, and local requirements.

Normal operations under all alternatives would reduce radiological impacts as compared to the existing TA-18 operations. There would be small differences in potential radiological impacts on the public among the site alternatives. However, for all site alternatives, public radiation exposure would be small and well below regulatory limits and limits imposed by DOE orders. For all sites, the maximally exposed offsite individual would receive less than 0.067 millirem per year from the normal operational activities at TA-18. Statistically, this translates into a risk that one additional fatal cancer would occur approximately every 29 million years due to these operations. Doses from SHEBA operations account for 90 percent of the calculated dose at LANL. The operational impacts at SNL/NM, NTS, and ANL-W would be significantly smaller because of lower radioactive releases and specifically remoteness of the latter two sites, leading to lower public radiation exposure. At all sites, the total dose to the population within 80 kilometers (50 miles) would be a maximum of 0.10 person-rem per year from normal operational activities at TA-18. Statistically, this would equate to one additional fatal cancer every 20,000 years. Again, doses from SHEBA operations account for 90 percent of the calculated dose at LANL. Further, due to the remoteness of NTS and ANL-W, and the fact that these sites have the smallest 50-mile-radius populations, the 50-mile-radius population dose would be the least at these sites.

Potential impacts from accidents were estimated using computer modeling. In the event of an accident involving the operational activities, the projected latent cancer fatalities at all relocation sites would be significantly less than 1. For the bounding accident analyzed in the EIS, the highest potential annual risk to the population within 80 kilometers (50 miles) from the TA-18 operations activities would be an increase in latent cancer fatalities of 5.1×10^{-5} from a potential hydrogen detonation accident at SHEBA. Statistically, this would equate to 1 additional latent cancer fatality among the affected population every 19,600 years of operation. Overall, the No Action Alternative, and specifically SHEBA operations, would produce the highest potential accident impact, primarily due to the fact that existing TA-18 facilities do not incorporate high-efficiency particulate air filtration, and, in the case of SHEBA, the design provides minimal containment.

3.5.4 Transportation Risks

Except for the No Action Alternative and the TA-18 Upgrade Alternative, all other site alternatives would require the transportation of equipment and materials. Such transportation would involve the relocation of approximately 2.4 metric tons (2.6 tons) of SNM, as well as approximately 10 metric tons (11 tons) of equipment, some of which would be radioactively contaminated. For all alternatives, the environmental impacts and potential risks of such transportation would be small. For all alternatives, the risks associated with radiological transportation would be less than one fatality per 10,000 years under normal and accident conditions. Although the potential risks would differ among the alternatives primarily as a function of the transportation distance, the impacts would be very small. Based on distance, the ANL-W Alternative would have the highest potential impact, the NTS Alternative the second-highest, the SNL/NM Alternative the third-highest, and the LANL New Facility Alternative the least risk (compared to the No Action and TA-18 Upgrade Alternatives).

3.5.5 Relocation of SHEBA and Other Security Category III/IV Activities

Relocation of SHEBA activities to TA-39 would entail the disturbance of approximately 0.08 hectares (0.2 acres) on a 1.6-hectare (4-acre) parcel of land for the construction of new buildings. Water main and utility lines would follow roadways to the new structures. Relocation of security Category III/IV activities to TA-55 would entail the disturbance of approximately 1.6 hectares (4 acres) on a 3.2-hectare (8-acre) parcel of land.

At either TA-55 or TA-39, the construction activities would not change the current land-use designation. The existing infrastructure would adequately support construction activities. Construction activities would result in temporary increases in air quality impacts, but would be below ambient air quality standards, except for short-term concentrations of total suspended particulates at TA-55. Construction activities would not significantly impact water, visual resources, biotic resources (including threatened and endangered species), geology and soils, or cultural and paleontological resources. The socioeconomic impacts associated with construction would not cause any major changes to the regional economic area employment, housing, or public finance. Waste generated during construction would be adequately managed by the existing LANL waste management infrastructure.

SHEBA operations at TA-39 would not have any significant impact on air, water, visual resources, biotic resources (including threatened and endangered species), geology and soils, cultural and paleontological resources, power usage, socioeconomics, or worker risks. All impacts would be within regulated limits and would comply with Federal, state, and local requirements. During SHEBA operations, approximately 100 curies of argon-41 per year would be released to the environment. This would result in a dose of 0.061 millirem to the maximally exposed member of the public, which is well below the limit of 10 millirem per year set by both the U.S. Environmental Protection Agency and DOE for airborne releases of radioactivity. For the bounding accident analyzed in the EIS, the highest potential annual risk to the population within 80 kilometers (50 miles) from the TA-18 operational activities would be an increase in latent cancer fatalities of 4.4×10^{-5} from a potential hydrogen detonation accident at SHEBA. Statistically, this would equate to 1 additional latent cancer fatality every 22,700 years of operation. The existing waste management facilities at LANL would be adequate to treat, store, and/or dispose of waste that would be generated by this mission.

3.5.6 Impacts Common to All Alternatives

Critical Assembly Machine Refurbishment. One impact that would be common to all alternatives under the proposed action is the one-time generation of approximately 1.5 cubic meters (2 cubic yards) of low-level and mixed low-level radioactive waste from the refurbishment of the criticality machines currently housed at TA-18. The radioactive waste would consist of old electrical racks, hydraulic systems, control cartridges, and machine stands that would be replaced by new components as part of TA-18 mission relocation activities. The refurbishment of these criticality machines would occur under any of the proposed alternatives. Disposition of the radioactive and nonradioactive waste would be in accordance with established procedures. The impact of managing this waste would be minimal given the available site capacity at LANL (see Section 4.2.12).

Decontamination and Decommissioning. All alternatives would require some level of decontamination and decommissioning. Operations experience with TA-18 critical assembly machines has shown that, although some surface contamination may result from the conduct of specific criticality experiments, the nature and magnitude of this contamination is such that it can be easily removed and reduced to acceptable levels. Consequently, impacts associated with decontamination and decommissioning are expected to be limited to waste created that is within LANL's and other alternative sites' waste management capabilities. This, therefore, would not be a discriminating factor among the alternatives.

Decontamination and decommissioning at TA-18 would also involve environmental restoration activities to reduce the long-term public and worker health and safety risks associated with potentially contaminated areas within the site or with surplus facilities and to reduce the risk posed to ecosystems. Decisions regarding whether and how to undertake environmental restoration action would be made after a detailed assessment of the short- and long-term risks and benefits within the framework of the Resource Conservation and Recovery Act (RCRA). The approach for controlling the consequences of environmental restoration activities at LANL is summarized in the *LANL SWEIS* (DOE 1999b). Decontamination and decommissioning of TA-18 would involve the general types of activities described and analyzed in the *LANL SWEIS* (e.g., generation of low-level radioactive waste). Specific alternatives to be considered in the decontamination and decommissioning process would likely follow the RCRA framework and will be subject to project-specific National Environmental Policy Act (NEPA) analysis.

Table 3–10 Summary of Environmental Impacts for the Relocation of TA-18 Capabilities and Materials

Resource/Material Categories	***No Action Alternative***		***TA-18 Upgrade Alternative***		***LANL New Facility Alternative***		***SNL/NM Alternative***	
Land Resource								
- Construction/Operations	No impact		0.5 acres/no impact		4.5 acres/no impact		4.5 acres/no impact	
Air Quality								
- Construction	No impact		Small temporary impact		Small temporary impact		Small temporary impact	
- Operations	110 curies per year of argon-41 released		110 curies per year of argon-41 released		10 curies per year of argon-41 released		10 curies per year of argon-41 released	
Water Resource								
- Construction	No impact		Small temporary impact		Small temporary impact		Small temporary impact	
- Operations	Small impact		Small impact		Small impact		Small impact	
Socioeconomics								
- Construction	No noticeable changes; No impact		No noticeable changes; 100 workers (peak); 422 jobs		No noticeable changes; 300 workers (peak); 1,152 jobs		No noticeable changes; 300 workers (peak)	
- Operations	No increase in workforce		No increase in workforce		No increase in workforce		20 people relocated or new hires	
Public and Occupational Health and Safety								
Normal Operations	***Dose***	***LCF***	***Dose***	***LCF***	***Dose***	***LCF***	***Dose***	***LCF***
- Population dose (person-rem per year)	0.10	0.00005	0.10	0.00005	0.011	5.5×10^{-6}	0.020	0.00001
- MEI (millirem per year)	0.067	3.4×10^{-8}	0.067	3.4×10^{-8}	0.0025	1.3×10^{-9}	0.00032	1.6×10^{-10}
- Average individual dose (millirem per year)	0.00030	1.5×10^{-10}	0.00030	1.5×10^{-10}	0.00004	2×10^{-11}	0.000026	1.3×10^{-11}
- Total worker dose (person-rem per year)	21	0.0085	21	0.0085	10 [b]	0.0040	10 [b]	0.0040
- Average worker dose (millirem per year)	100	0.00004	100	0.00004	100	0.00004	100	0.00004
Hazardous Chemicals	None		None		None		None	
Accidents (Maximum Annual Cancer Risk, LCF)								
- Population	5.1×10^{-5}		5.1×10^{-5}		9.1×10^{-8}		2.2×10^{-7}	
- MEI	1.7×10^{-7}		1.7×10^{-7}		6.1×10^{-11}		1.7×10^{-11}	
- Noninvolved worker	2.0×10^{-6}		2.0×10^{-6}		2.8×10^{-9}		2.8×10^{-9}	
Chemical Accidents	None							
Environmental Justice	No disproportionally high and adverse impacts on minority or low-income populations							
Waste Management (cubic meters of solid waste per year): Waste would be disposed of properly with small impact								
- Low-level radioactive waste [d]	145		145		145		145	
- Mixed low-level radioactive waste [d]	1.5		1.5		1.5		1.5	
- Hazardous waste	4		4		4		4	
Transportation								
- Incident-free	***Person-rem***	***LCF***	***Person-rem***	***LCF***	***Person-rem***	***LCF***	***Person-rem***	***LCF***
- Population	(f)	(f)	(f)	(f)	(f)	(f)	0.040	0.000020
- Workers	(f)	(f)	(f)	(f)	(f)	(f)	0.025	0.000010
Accidents								
- Population	(f)	(f)	(f)	(f)	(f)	(f)	7.0×10^{-6}	3.5×10^{-9}

LCF = latent cancer fatality; MEI = maximally exposed individual.

[a] Impacts to be considered in conjunction with the relocation of security Category I/II capabilities and materials if the security Category III/IV activities do not remain at TA-18.

[b] There would be an additional one-time dose to the workers of 2.3 person-rem from handling activities of the SNM that would be transported from TA-18 to the alternative site.

[c] There would be an additional one-time dose to workers of 0.02 person-rem from handling activities of materials associated with SHEBA operations.

NTS Alternative		**ANL-W Alternative**		**SHEBA Relocation to TA-39** [a]		**Other Security Category III/IV Relocation to TA-55** [a]	
1.7 acres/no impact		1.5 acres/no impact		0.2 acres/no impact		4.1 acres/no impact	
Small temporary impact		Small temporary impact		Small temporary impact		Small temporary impact	
10 curies per year of argon-41 released		10 curies per year of argon-41 released		100 curies per year of argon-41 released		Trace level of radioactivity released	
Small temporary impact		Small temporary impact		Small temporary impact		Small temporary impact	
Small impact		Small impact		Small impact		Small impact	
No noticeable changes; 60 workers (peak)		No noticeable changes; 120 workers (peak)		No noticeable changes; 25 workers (peak)		No noticeable changes; 45 workers (peak)	
20 people relocated or new hires		20 people relocated or new hires		No increase in workforce		No increase in workforce	
Dose	***LCF***	***Dose***	***LCF***	***Dose***	***LCF***	***Dose***	***LCF***
0.000070	3.5×10^{-8}	0.00041	2.1×10^{-7}	0.087	0.000044	Small	
0.000087	4.4×10^{-11}	0.00021	1.1×10^{-10}	0.061	3.0×10^{-8}	Small	
3.9×10^{-6}	1.9×10^{-12}	1.7×10^{-6}	8.6×10^{-13}	0.00019	1.0×10^{-10}	Small	
10 [b]	0.0040	10 [b]	0.0040	11 [c]	0.0045	Small	
100	0.00004	100	0.00004	100	0.00004	Small	
None		None		None		None	
7.7×10^{-10}		7.7×10^{-9}		4.9×10^{-5}		Small	
2.5×10^{-12}		7.3×10^{-12}		1.4×10^{-7}		Small	
4.0×10^{-9}		7.2×10^{-9}		2.0×10^{-6}		Small	
None							
No disproportionally high and adverse impacts on minority or low-income populations							
145		145		(e)		(e)	
1.5		1.5		(e)		(e)	
4		4		(e)		(e)	
Person-rem	***LCF***	***Person-rem***	***LCF***	***Person-rem***	***LCF***	***Person-rem***	***LCF***
0.33	0.00016	0.39	0.00019	(f)	(f)	(f)	(f)
0.25	0.00010	0.28	0.00011	(f)	(f)	(f)	(f)
0.000028	1.4×10^{-8}	0.000038	1.9×10^{-8}	(f)	(f)	(f)	(f)

[d] There would be a one-time generation of 1.5 cubic meters of low-level radioactive and mixed low-level radioactive waste at LANL from the refurbishment of the critical assembly machines.

[e] Waste generation from SHEBA, security Category III/IV, and security Category I/II activities would be similar to those generated under the No Action Alternative.

[f] LANL intrasite SNM and material transportation impacts would be bounded by the normal operation and accident impacts evaluated for the various LANL alternatives.

3.6 PREFERRED ALTERNATIVE

Council on Environmental Quality regulations require an agency to identify its preferred alternative, if one or more exists, in the draft EIS (40 CFR 1502.14(e)). The preferred alterative is the alternative which the agency believes would fulfill its statutory mission, giving consideration to environmental, economic, technical, and other factors. When the former Secretary of Energy announced that DOE would prepare this *TA-18 Relocation EIS*, it was also announced that a new location at LANL to conduct the TA-18 operations and store associated materials was the Preferred Alternative (the LANL New Facility Alternative).

CHAPTER 4

Affected Environment

4. AFFECTED ENVIRONMENT

In Chapter 4, the affected environment descriptions provide the context for understanding the environmental consequences described in Chapter 5. They serve as a baseline from which any environmental changes brought about by implementing the proposed action can be evaluated; the baseline conditions are the currently existing conditions. The affected environments at Los Alamos National Laboratory, Sandia National Laboratories/New Mexico, Nevada Test Site, and Argonne National Laboratory-West are described for the following impact areas: land resources, site infrastructure, air quality, noise, geology and soils, water resources, ecological resources, cultural and paleontological resources, socioeconomics, environmental justice, existing human health risk, and waste management.

4.1 APPROACH TO DEFINING THE AFFECTED ENVIRONMENT

In accordance with the Council on Environmental Quality guidance under National Environmental Policy Act (NEPA) regulations (40 CFR 1500 through 1508) for preparing an environmental impact statement (EIS), the affected environment is "Interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." The affected environment descriptions presented in this chapter provide the context for understanding the environmental consequences described in Chapter 5. They serve as a baseline from which any environmental changes brought about by implementing the proposed action can be evaluated; the baseline conditions are the currently existing conditions.

For this *Draft Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory*, (*TA-18 Relocation EIS*) the candidate sites are Los Alamos National Laboratory (LANL); Sandia National Laboratories/New Mexico (SNL/NM), located within the boundaries of Kirtland Air Force Base (KAFB); Nevada Test Site (NTS); and Argonne National Laboratory-West (ANL-W), located within the boundaries of the Idaho National Engineering and Environmental Laboratory (INEEL). The affected environment is described for the candidate sites for the following resource areas: land resources, site infrastructure, air quality, noise, geology and soils, water resources, ecological resources, cultural and paleontological resources, socioeconomics, environmental justice, existing human health risk, and waste management. For each U.S. Department of Energy (DOE) site, each resource area is described first for the site as a whole and then for the candidate sites, as appropriate. The level of detail varies depending on the potential for impacts resulting from each relocation alternative.

The Solution High-Energy Burst Assembly (SHEBA) could be relocated from TA-18 to a new building constructed at LANL's TA-39, and other security Category III/IV activities could be relocated to TA-55. LANL's TA-18 and TA-55 affected environments are presented in this chapter. LANL's TA-39 affected environment is presented separately in Chapter 5, Section 5.6.2, in association with the separate SHEBA and other security Category III/IV relocation analysis.

The following site-specific and recent project-specific documents were important sources of information in describing the existing environment at each of the proposed relocation sites. Numerous other sources of site- and resource-related data were also used in the preparation of this chapter and are cited as appropriate.

- *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory (LANL SWEIS)* (DOE 1999b)

- *Final Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico (SNL/NM SWEIS)* (DOE 1999f)

- *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (NTS SWEIS)* (DOE 1996e)

- *Idaho High-Level Waste and Facilities Disposition Draft Environmental Impact Statement* (DOE 1999j)

- *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (DOE 2000e)

- *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility (NI PEIS)* (DOE 2000k)

DOE evaluated the environmental impacts of the proposed action within defined regions of influence at each of the candidate sites and along potential transportation routes. The regions of influence are specific to the type of effect evaluated, and encompass geographic areas within which any significant impact would be expected to occur. For example, human health risks to the general public from exposure to airborne contaminant emissions were assessed for an area within an 80-kilometer (50-mile) radius of the proposed facilities. The human health risks of shipping materials between sites were evaluated for populations living along roadways linking the DOE sites. Economic effects such as job and income changes were evaluated within a socioeconomic region of influence that include the county in which the site is located and nearby counties in which substantial portions of the site's workforce reside. Brief descriptions of the regions of influence are given in **Table 4–1**. More detailed descriptions of the regions of influence and the methods used to evaluate impacts are presented in Appendix F.

Table 4–1 General Regions of Influence for the Affected Environment

Environmental Resources	*Region of Influence*
Land resources	The site and the areas immediately adjacent to the site
Site infrastructure	The site
Air quality	The site, nearby offsite areas within local air quality control regions, where significant air quality impacts may occur, and Class I areas within 100 kilometers
Noise	The site, nearby offsite areas, access routes to the sites, and the transportation corridors
Geology and soils	Geologic and soil resources within the site and nearby offsite areas
Water resources	Onsite and adjacent surface water bodies and groundwater
Ecological resources	The site and adjacent areas
Cultural and paleontological resources	The area within the site and adjacent to the site boundary
Socioeconomics	The counties where approximately 90 percent of site employees reside
Environmental justice	The minority and low-income populations within 80 kilometers (50 miles) of the site, and along the transportation corridors between the sites
Existing human health risk	The site, offsite areas within 80 kilometers (50 miles) of the site, and the transportation corridors between the sites where worker and general population radiation, radionuclide, and hazardous chemical exposures may occur
Waste management	The site

At each of the candidate sites, baseline conditions for each environmental resource area were determined for ongoing operations from information provided in previous environmental studies, relevant laws and regulations, and other Government reports and databases. More detailed information of the affected environment at the candidate sites can be found in annual site environmental reports and site NEPA documents.

4.2 LOS ALAMOS NATIONAL LABORATORY

LANL is located on 11,272 hectares (27,832 acres) of land in north central New Mexico (**Figure 4–1**). The site is located 97 kilometers (60 miles) north-northeast of Albuquerque, 40 kilometers (25 miles) northwest of Santa Fe, and 32 kilometers (20 miles) southwest of Española. LANL is owned by the Federal Government and administered by DOE's National Nuclear Security Administration (NNSA). It is operated by the University of California under contract to DOE. Portions of LANL are located in Los Alamos and Santa Fe Counties. DOE's principal missions are national security, energy resources, environmental quality, and science and each of these missions is supported by activities conducted at LANL.

LANL is divided into 49 separate technical areas (TAs) with location and spacing that reflect the site's historical development patterns, regional topography, and functional relationships (**Figure 4–2**). While the number of structures changes somewhat with time (e.g., as a result of the recent Cerro Grande Fire; see Section 4.2.1.1), there are 944 permanent structures; 512 temporary structures; and 806 miscellaneous buildings with approximately 465,000 square meters (5,000,000 square feet) that could be occupied. In addition to onsite office space, 19,833 square meters (213,262 square feet) of space is leased within the Los Alamos town site and White Rock community (DOE 1999b).

TA-18 is the current location of the Los Alamos Critical Experiments Facility. Facilities within this TA study both static and dynamic behavior of critical assemblies of nuclear materials. Special nuclear materials (SNM) are used to support a wide variety of activities for stockpile management, stockpile stewardship, emergency response, nonproliferation, and safeguards. In addition, this facility provides the capability to perform hands-on training and experiments with SNM in various configurations below critical (DOE 1999b).

TA-55 is one of the sites proposed for the relocation of missions currently performed at TA-18. TA-55 is located in the west-central portion of LANL. TA-55 facilities provide research and applications in chemical and metallurgical processes for recovering, purifying, and converting plutonium and other actinides into many compounds and forms, as well as research into material properties and fabrication of parts for research and stockpile applications. Additional activities include the means to safely and securely ship, receive, handle, and store nuclear materials, as well as manage the waste and residue produced by TA-55 operations (DOE 1999b). Unless otherwise referenced, the following descriptions of the affected environment at LANL, TA-18, and TA-55 are based all or in part on information provided in the *LANL SWEIS* (DOE 1999b), which is incorporated by reference.

4.2.1 Land Resources

4.2.1.1 Land Use

Land use in this region is linked to the economy of northern New Mexico, which depends heavily on tourism, recreation (e.g., skiing, fishing), agriculture, and the state and Federal Governments for its economic base. Area communities are generally small, such as the Los Alamos town site with under 12,000 residents, and primarily support urban uses including residential, commercial, light industrial, and recreational facilities. The region also includes Native American communities; lands of the Pueblo of San Ildefonso share LANL's eastern border, and a number of other pueblos are clustered nearby. Major governmental bodies that serve as land stewards and determine land uses within Los Alamos and Sante Fe counties include the county governments, DOE, the U.S. Forest Service, the National Park Service, the State of New Mexico, the U.S. Bureau of Land Management, and several Native American pueblos. Bandelier National Monument and

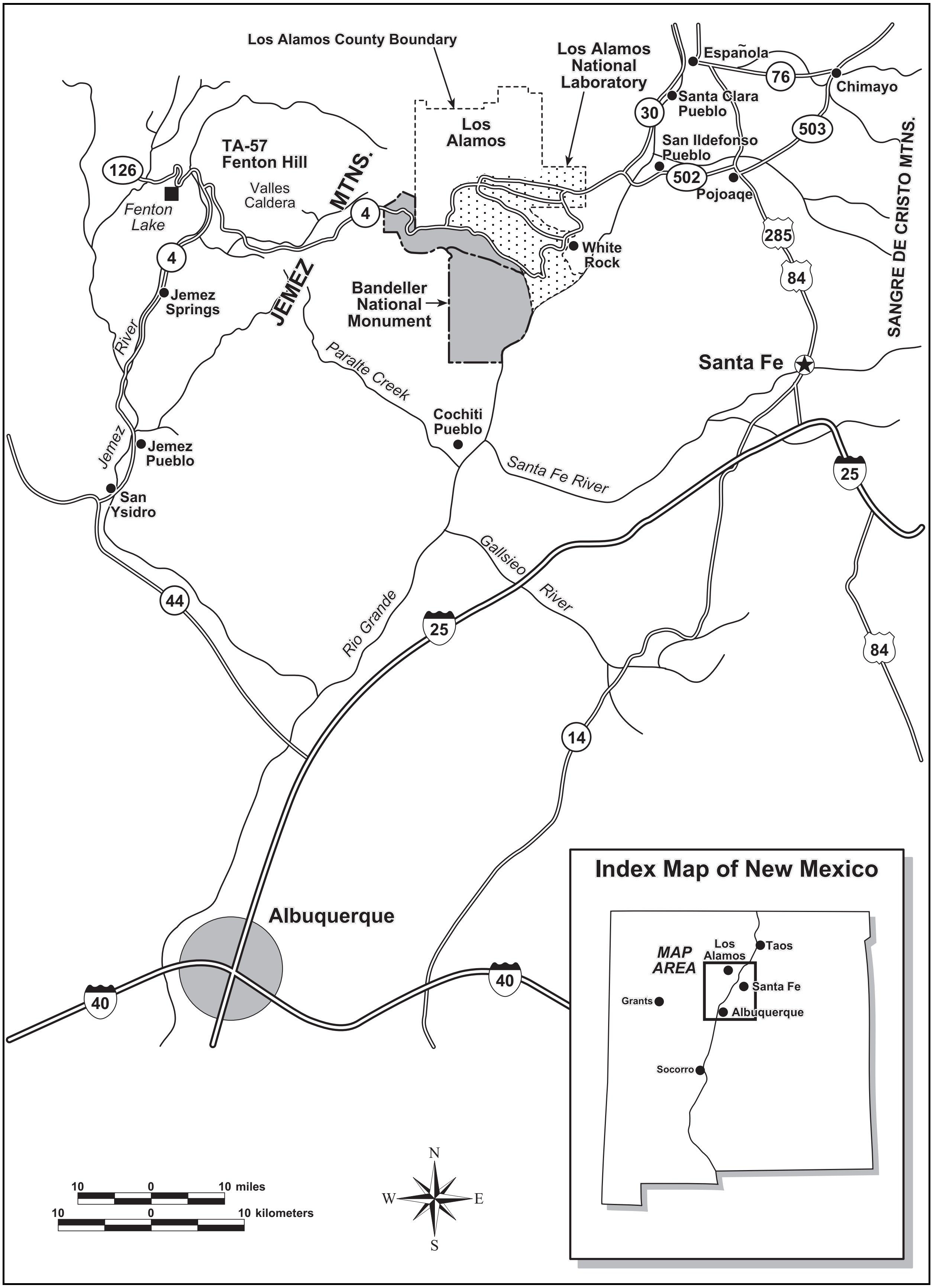


Figure 4–1 Location of LANL

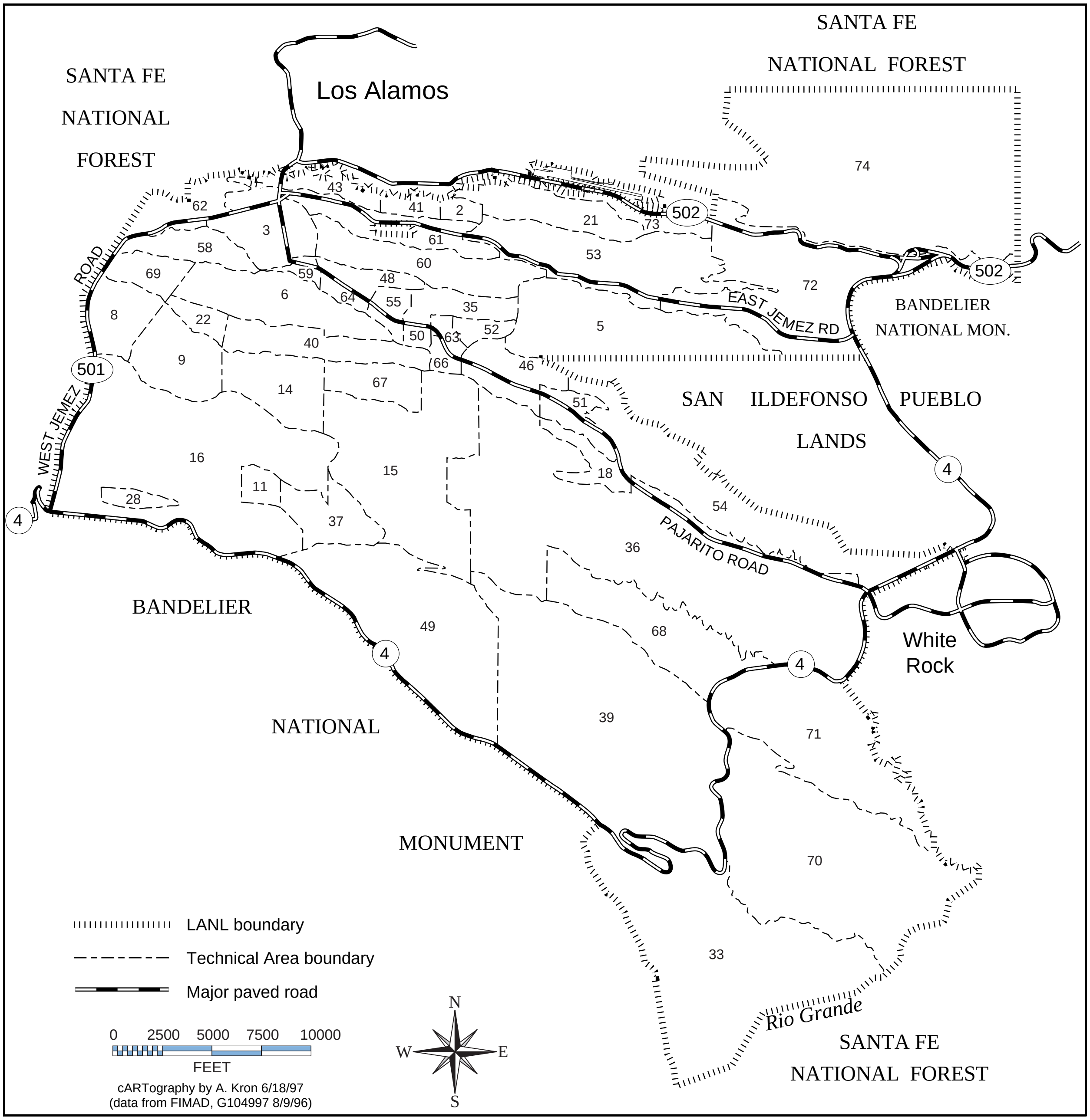


Figure 4–2 Technical Areas of LANL

Santa Fe National Forest border LANL primarily to the southwest and northwest, respectively; however, small portions of each also border the site to the northeast (see **Figure 4–3**).

Land use characterization at LANL is based on the most hazardous activities in each TA and is organized into six categories.

Support—Includes TAs with only support facilities that do not perform research and development activities and are generally free from chemical, radiological, or explosive hazards; also includes undeveloped TAs other than those that serve as buffers.

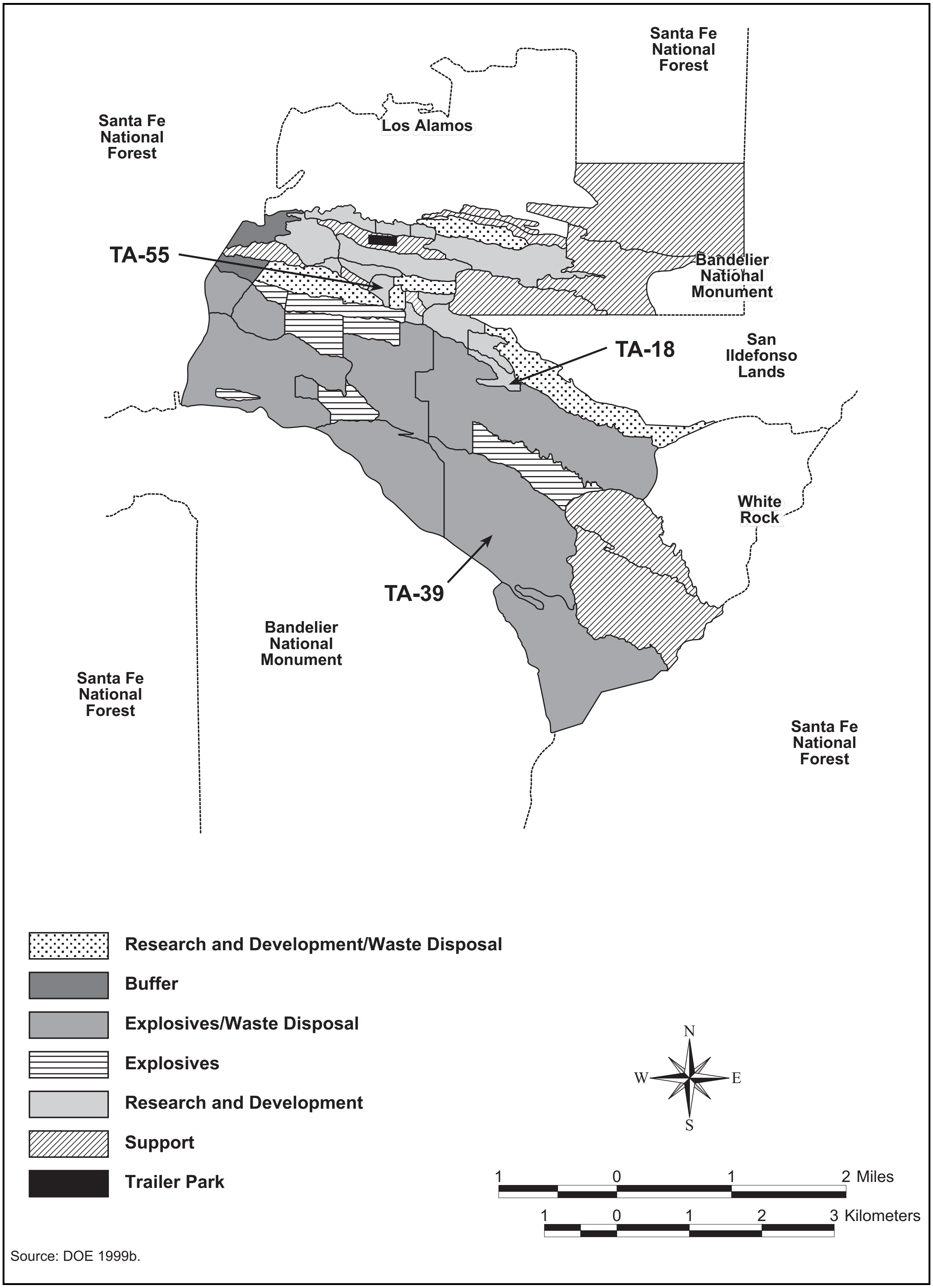


Figure 4–3 Land Use at LANL

Research and Development—Includes TAs that perform research and development activities with associated chemical and radiological hazards, but that are generally free of explosives hazards; does not include waste disposal sites.

Research and Development/Waste Disposal—The remaining research and development areas (i.e., those areas that are generally free of explosives hazards and have existing waste disposal sites).

Explosives—Includes TAs where explosives are tested or stored, but does not include waste disposal sites.

Explosives/Waste Disposal—The remaining sites where explosives are tested or stored (i.e., those with existing waste disposal sites).

Buffer—Land identified in each of the usage types described above also may serve as a buffer area. This last land use category therefore includes areas that only serve as buffers for the safety or security of other TAs, usually explosives areas.

LANL is divided into TAs that are used for building sites, experimental areas, and waste disposal locations. However, those uses account for only a small part of the total land area of the site. In fact, only 5 percent of the site is estimated to be unavailable to most wildlife (because of security fencing). Most of the site is undeveloped to provide security, safety, and expansion possibilities for future mission requirements. There are no agricultural activities present at LANL, nor are there any prime farmlands. In 1977, DOE designated LANL as a National Environmental Research Park, which is used by the national scientific community as an outdoor laboratory to study the impacts of human activities on pinyon-juniper woodland ecosystems (DOE 1996g). In 1999, the White Rock Canyon Wildlife Reserve was dedicated. It is about 405 hectares (1,000 acres) in size and is located on the southeast perimeter of LANL. The reserve is managed jointly by DOE and the National Park Service for its significant ecological and cultural resources and research potential (LANL 2000f).

Beginning on May 5, 2000, a wildfire, know as the Cerro Grande Fire, burned across the Los Alamos area. By the time the fire was fully contained on June 6, it had burned a total of 17,462 hectares (43,150 acres), of which 3,061 hectares (7,650 acres) were within the boundaries of LANL. In general, impacts of the fire on land use in the region should be temporary. For example, access and use of certain recreation areas and trails will be restricted over the next two to three years within at least part of LANL and the surrounding forestlands. Within LANL, 45 structures (trailers, transportable, and storage units) were totally destroyed and 67 were damaged. The fire also affected land use in the Los Alamos town site, where about 230 housing units were totally destroyed (LANL 2000b, DOE 2000h).

The Los Alamos County Comprehensive Plan, which established land planning issues and objectives, addresses private and county lands comprising 3,488 hectares (8,613 acres). Twenty-nine percent of this land is located within the Los Alamos town site and 26 percent is located in the community of White Rock. The remaining 45 percent of the land is undeveloped and is used for recreational activities and open space. LANL is autonomous from a planning perspective and, therefore, is not addressed in the county plan. Land-use designations in the Santa Fe County Plan are based on groundwater protection goals. Therefore, this plan designates LANL as "Agricultural and Residential," although, as noted above, there are no agricultural activities on the site, nor are there any residential uses within LANL boundaries (DOE 1996g).

TA-18 is located within the Research and Development land use category (Figure 4–3). Facilities at TA-18 are located on a 53-hectare (131-acre) site that is situated 4.8 kilometers (3 miles) from the nearest residential area, White Rock. Approximately 20 percent of the site has been developed. Site facilities are located in a canyon near the confluence of Pajarito Canyon and Three Mile Canyon. TA-18 structures include a main building, three outlying remote-controlled critical assembly buildings known as CASAs, and several smaller laboratory, nuclear material storage, and support buildings. A security fence to aid in physical safeguarding of SNM bounds the entire site (see Figure 3–1).

TA-55 is also located within the Research and Development land use category (see Figure 4–3). Facilities at TA-55 are located on a 16-hectare (40-acre) site that is situated 1.8 kilometers (1.1 miles) south of the city of Los Alamos. Forty-three percent of the site has been developed. The main complex has five connected buildings; the Nuclear Materials Storage Facility is separate from the main complex but shares an underground transfer tunnel. A security fence to aid in physical safeguarding of SNM bounds the entire site (see Figure 3–1).

The Cerro Grande Fire at times threatened structures at TA-18 and TA-55 (LANL 2000b). However, no permanent buildings were damaged or destroyed.

4.2.1.2 Visual Resources

The topography in northern New Mexico is rugged, especially in the vicinity of LANL. Mesa tops are cut by deep canyons, creating sharp angles in the land form. In some cases, slopes are nearly vertical. Often, little vegetation grows on these steep slopes, exposing the geology, with contrasting horizontal planes varying from fairly bright reddish orange to almost white in color. A variety of vegetation occurs in the region, the density of vegetation and height of which may change over time and can affect the visibility of an area within the LANL viewshed. Undeveloped lands within LANL have a Bureau of Land Management Visual Resource Contrast rating of Class II and III. Management activities within these classes may be seen but should not dominate the review.

For security reasons, much of the development within LANL has occurred out of the public’s view. Passing motorists or nearby residents can see only a small fraction of what is actually there. Prior to the Cerro Grande Fire, the view of most LANL property from many stretches of area roadways was that of woodlands and brushy areas. Views from various locations in Los Alamos County and its immediate surroundings have been altered by the Cerro Grande Fire, which burned over 17,462 hectares (43,150 acres) of the area in the summer of 2000. Although the visual environment is still diverse, interesting, and panoramic, portions of the visual landscape are dramatically stark. Rocky outcrops forming the mountains are now visible through the burned forest areas. The eastern slopes of the Jemez Mountains, instead of presenting a relatively uniform view of dense green forest, are now a mosaic of burned and unburned areas. Grasses and shrubs initially will replace forest stands and will contribute to the visual contrast between the burned and unburned areas for many years. Local effects include reduced visual appeal of trails and recreation areas (DOE 2000h).

The most visible developments at LANL are a limited number of very tall structures; facilities at relatively high, exposed locations; or those beside well-traveled, publicly accessible roads within the core part of LANL, the TA-3 area. Developed areas within LANL are consistent with a Class IV Visual Resource Contrast rating, in which management activities dominate the view and are the focus of viewer attention.

At lower elevations, at a distance of several miles away from LANL, the facility is primarily distinguishable in the daytime by views of its water storage towers, emission stacks, and occasional glimpses of older buildings that are very austere and industrial in appearance. Similarly, the Los Alamos town site appears mostly residential in character, with the water storage towers very visible against the backdrop of the Jemez Mountains. At elevations above LANL, along the upper reaches of the Pajarito Plateau rim, the view of LANL is primarily of scattered austere buildings and the nested several-storied buildings of TA-3. Similarly, the residential character of the Los Alamos town site is predominately visible from higher elevation viewpoints. At night, the lights of LANL, the Los Alamos town site, and White Rock are directly visible from various locations across the viewshed as far away as the towns of Española and Santa Fe.

TA-18 is located at the bottom of a canyon at the confluence of Pajarito Canyon and Threemile Canyon. Since the surrounding canyon walls rise approximately 61 meters (200 feet) above the site, TA-18 is not visible from any offsite location, including White Rock, which is located 4.8 kilometers (3 miles) to the east. Developed portions of TA-18 would have a Class IV Visual Resource Contrast rating.

TA-55 is located on a mesa about 1.6 kilometers (1 mile) southeast of TA-3. While not visible from lower elevations, TA-55 is visible from higher elevations to the west along the upper reaches of the Pajarito Plateau rim, from where it appears as one of several scattered built-up areas among the heavily forested areas of the site. As is the case for TA-18, developed portions of TA-55 would have a Class IV Visual Resource Contrast rating.

4.2.2 Site Infrastructure

Site infrastructure characteristics for LANL are summarized in **Table 4–2**.

Table 4–2 LANL Sitewide Infrastructure Characteristics

Resource	*Site Usage*	*Site Capacity*
Transportation		
Roads (kilometers)	130 [a]	Not applicable
Railroads (kilometers)	0	Not applicable
Electricity [b]		
Energy (megawatt-hours per year)	475,868	937,000
Peak load (megawatts)	83	107
Fuel		
Natural gas (cubic meters per year)	70,000,000 [c]	229,400,000 [d]
Liquid fuels (liters per year)	Negligible	Not limited
Coal (metric tons per year)	0	0
Water (liters per year)	1,715,000,000	2,050,000,000 [e]

[a] Includes paved roads and paved parking areas only.
[b] Usage and capacity values are for the entire Los Alamos Power Pool.
[c] Usage value for LANL plus baseline usage for other Los Alamos County users.
[d] Entire service area capacity which includes LANL and other Los Alamos area users.
[e] Equivalent to 30 percent of the water right allocation from the main aquifer.
Source: DOE 1999b, DOE 1999h, LANL 2000e.

4.2.2.1 Ground Transportation

About 130 kilometers (80 miles) of paved roads and parking surface have been developed on LANL (see Table 4–2). There is no railway service connection at the site. Local and linking regional transportation systems, including roadways, are detailed in Section 4.2.9.4.

4.2.2.2 Electricity

Electrical service to LANL is supplied through a cooperative arrangement with Los Alamos County, known as the Los Alamos Power Pool, which was established in 1985. Electric power is supplied to the pool through two existing regional 115-kilovolt electric power lines. The first line (the Norton-Los Alamos line) is administered by DOE and originates from the Norton Substation near White Rock, and the second line (the Reeves Line) is owned by the Public Service Company of New Mexico and originates from the

Bernalillo-Algodones Substation. Both substations are owned by the Public Service Company of New Mexico. DOE also operates a gas-fired steam/power plant at TA-3 that is used on an as-needed basis and maintains various low-voltage transformers at LANL facilities and approximately 55 kilometers (34 miles) of 13.8-kilovolt distribution lines (DOE 2000c).

Pool resources currently provide a contractually limited 73 megawatts during winter months to about 95 megawatts during the spring and early summer months from a number of hydroelectric, coal, and natural gas power generators throughout the western United States (LANL 2000e). Onsite electric generating capacity for the pool is limited to the existing TA-3 steam/power plant, which has an operating capacity of 12 megawatts in the summer and 15 megawatts in the winter. Historically, offsite power system failures have disrupted operations in LANL facilities. Therefore, all facilities that require safe shutdown capability for power outages are equipped with emergency generators to assure these needs are met, including nuclear facilities such as TA-55 and the Chemistry and Metallurgy Research Building. The TA-3 steam/power plant currently provides the additional electricity needed to meet peak load demands exceeding the allowable supply. The TA-3 steam/power plant and the majority of LANL's electrical distribution network are past or nearing the end of their design life and require replacement or upgrading. To improve overall supply reliability, construction and operation of a new 115-kilovolt power line is planned that would originate at the existing Public Service Company of New Mexico-owned Norton Substation and terminate at a proposed DOE-administered West Technical Area Substation (DOE 2000c).

Electricity consumption and peak demands by LANL have historically fluctuated largely as a result of power demand by the Los Alamos Neutron Science Center. Electric power availability from the pool (based on a summer peak load capacity of 107 megawatts) is 937,000 megawatt-hours per year (DOE 1999h). In fiscal year 1999 (FY99), LANL used 369,321 megawatt-hours of electricity which was an eight-year low. Other Los Alamos County users consumed an additional 106,547 megawatt-hours. The FY99 peak load usage was about 68 megawatts for LANL and about 14 megawatts for the rest of the county (LANL 2000e). The estimated peak load capacity is 107 megawatts during the summer peak season (see Table 4–2) (DOE 1999h). In FY 2000, TA-55 used 14,158 megawatt-hours of electricity. Electric power usage at TA-18 is estimated to consistently average 2,836 megawatt-hours annually (LANL 2001a).

4.2.2.3 Fuel

Natural gas is the primary fuel used in Los Alamos County and at LANL. The natural gas system includes a high-pressure main and distribution system to Los Alamos County and pressure-reducing stations at LANL buildings. In August 1999, DOE sold the 209-kilometer-long (130-mile) main gas supply line and associated metering stations to Los Alamos and vicinity to Public Service Company of New Mexico (LANL 2000e). The county and LANL both have delivery points where gas is monitored and measured. LANL burns natural gas to generate steam to heat buildings. The natural gas delivery system servicing the Los Alamos area has a contractually-limited capacity of about 229 million cubic meters (8.07 billion cubic feet) per year (DOE 1999h). In FY99, LANL used approximately 40.5 million cubic meters (1.43 billion cubic feet) of natural gas (see Table 4–2). Some 90 percent of the natural gas used at LANL is for heating and the remainder for electricity generation to meet peak demands (LANL 2000e). The rest of the service area including Los Alamos County is estimated to use an average of 29.5 million cubic meters (1.04 billion cubic feet) of natural gas annually (DOE 1999h). Relatively small quantities of fuel oil are also stored at LANL as a backup fuel source and use is therefore negligible (DOE 1996g). TA-18 and TA-55 use natural gas to fire boilers and for other facility uses. Natural gas usage at TA-18 is estimated to be about 200 cubic meters (7,000 cubic feet) per year. TA-55 is estimated to use approximately 1.3 million cubic meters (45 million cubic feet) of natural gas annually (LANL 2001a).

4.2.2.4 Water

The Los Alamos potable water production system consists of 14 deep wells, 246 kilometers (153 miles) of main distribution lines, pump stations, storage tanks, and nine chlorination stations. On September 8, 1998, DOE transferred operation of the system from the LANL to Los Alamos County under a lease agreement. Under this agreement, LANL retained responsibility for operating the distribution system within its boundaries, whereas the county assumed full responsibility for operating the water system, including ensuring compliance with Federal and state drinking water regulations (LANL 2000f). The system supplies potable water to all of the county, LANL, and Bandelier National Monument. DOE's rights to withdraw an equivalent of about 6,830 million liters (1,806 million gallons) of water per year from the main aquifer and its right to purchase a water allocation from the San Juan-Chama Transmountain Diversion Project were included in the lease agreement. DOE plans to ultimately convey 70 percent of the water rights to the county (including the entire San Juan-Chama right) and lease the remainder to the county (LANL 2000e). Per the current lease agreement, LANL would retain the right to purchase the leased percentage with provision to purchase water in excess of the 30 percent (equivalent to about 2.05 billion liters [542 million gallons] annually) if available (DOE 1999h). Before transfer of the Los Alamos water supply system in October 1998, LANL's water use was estimated by subtracting the county's metered water use from total well production that resulted in counting other users such as Bandelier National Monument and system losses in the LANL water use total.

In 1999, LANL used approximately 1.71 billion liters (453 million gallons) of water (LANL 2000e) (see Table 4–2). Potable water is obtained from deep wells located in three well fields (Gauje, Otowi, and Pajarito). Nonpotable water is also supplied to the TA-16 steam plant from the Water Canyon Gallery. This system consists of about 1.6 kilometers (1 mile) of water line and a catchment basin improvement to a spring. TA-18 currently uses about 14.65 million liters (3.87 million gallons) of water annually.

4.2.3 Air Quality

Los Alamos has a semiarid, temperate mountain climate. This climate is characterized by seasonable, variable rainfall with precipitation ranging from 25 to 51 centimeters (10 to 20 inches) per year. The climate of the Los Alamos town site is not as dry (arid) as that part near the Rio Grande, which is arid continental. Meteorological conditions within Los Alamos are influenced by the elevation of the Pajarito Plateau. Climatological averages for atmospheric variables such as temperature, pressure, winds, and precipitation presented are based on observations made at the official Los Alamos meteorological weather station from 1961 to 1990. Normal (30-year mean) minimum and maximum temperatures for the community of Los Alamos range from a mean low of -8.1 °C (17.4 °F) in January to a mean high of 27 °C (80.6 °F) in July. Normal (30-year mean) minimum and maximum temperatures for the community of White Rock range from a mean low of -9.7 °C (14.6 °F) in January to a mean high of 29.8 °C (85.6 °F) in July. Temperatures in Los Alamos vary with altitude, averaging 3 °C (5 °F) higher in and near the Rio Grande Valley, which is 1,981 meters (6,500 feet) above sea level, and 3 to 5.5 °C (5 to 10 °F) lower in the Jemez Mountains, which are 2,600 to 3,050 meters (8,500 to 10,000 feet) above sea level. Los Alamos town site temperatures have dropped as low as -28 °C (-18 °F) and have reached as high as 35 °C (95 °F). The normal annual precipitation for Los Alamos is approximately 48 centimeters (19 inches). Annual precipitation rates within the county decline toward the Rio Grande Valley, with the normal precipitation for White Rock at approximately 34 centimeters (14 inches). The Jemez Mountains receive over 64 centimeters (25 inches) of precipitation annually. The lowest recorded annual precipitation in Los Alamos town site was 17 centimeters (7 inches) and the highest was 1 meter (39 inches).

Thirty-six percent of the annual precipitation for Los Alamos County and LANL results from thundershowers that occur in July and August. Winter precipitation falls primarily as snow. Average annual snowfall is approximately 150 centimeters (59 inches), but can vary considerably from year to year. Annual snowfall ranges from a minimum of 24 centimeters (9 inches) to a maximum of 389 centimeters (153 inches).

Los Alamos County winds average 3 meters per second (7 miles per hour). Wind speeds vary throughout the year, with the lowest wind speeds occurring in December and January. The highest winds occur in the spring (March through June), due to intense storms and cold fronts. The highest recorded wind in Los Alamos County was 34 meters per second (77 miles per hour). Surface winds often vary dramatically with the time of day, location, and elevation, due to Los Alamos' complex terrain.

In addition to seasonal changes in wind conditions, surface winds often vary with the time of day. An up-slope air flow often develops over the Pajarito Plateau in the morning hours. By noon, winds from the south usually prevail over the entire plateau. The prevalent nighttime flow ranges from the west-southwest to northwest over the western portion of the plateau. These nighttime winds result from cold air drainage off the Jemez Mountains and the Pajarito Plateau. Analyses of Los Alamos Canyon wind data indicate a difference between the atmospheric flow in the canyon and the atmospheric flow over the Pajarito Plateau. Cold air drainage flow is observed about 75 percent of the time during the night and continues for an hour or two after sunrise until an up-canyon flow forms. Wind conditions are discussed further in the *LANL SWEIS*.

Thunderstorms are common in Los Alamos County, with an average of 60 thunderstorms occurring in a year. Lightning can be frequent and intense. The average number of lightning-caused fires in the 1,104 hectares (2,727 acres) of Bandelier National Monument for the years 1990 through 1994 is 12 per year. There are no recorded instances of large-scale flooding in Los Alamos County. However, flash floods from heavy thunderstorms are possible in areas such as arroyos, canyons, and low-lying areas. No tornadoes are known to have touched the ground in the Los Alamos area.

4.2.3.1 Nonradiological Releases

LANL operations can result in the release of nonradiological air pollutants that may affect the air quality of the surrounding area. LANL is within the Upper Rio Grande Valley Intrastate Air Quality Control Region (#157). The area encompassing LANL and Los Alamos County is classified as an attainment area for all six criteria pollutants (i.e., carbon monoxide, nitrogen dioxide, lead, ozone, sulfur dioxide, and particulate matter) (40 CFR 81.332).

In addition to the National Ambient Air Quality Standards (NAAQS) established by the U.S. Environmental Protection Agency (EPA), the State of New Mexico has established ambient air quality standards for carbon monoxide, sulfur dioxide, nitrogen dioxide, total suspended particulates, hydrogen sulfide, and total reduced sulfur. Additionally, New Mexico established permitting requirements for new or modified sources of regulated air pollutants. Air quality permits have been obtained from the State Air Quality Bureau for beryllium operations, a rock crusher, and LANL's power plant that were modified or constructed after August 31, 1972. In accordance with Title V of the Clean Air Act, as amended, and New Mexico Administrative Code 202.72.402, the University of California and DOE submitted a sitewide operating permit application to New Mexico Environment Department in December 1995. The New Mexico Environment Department has reviewed this application and issued a Notice of Completeness, but has not yet issued an operating permit.

Criteria pollutants released from LANL operations are emitted primarily from combustion sources such as boilers, emergency generators, and motor vehicles. **Table 4–3** presents information regarding the primary existing sources. Toxic air pollutant emissions from LANL activities are released primarily from laboratory, maintenance, and waste management operations. Unlike a production facility with well-defined operational processes and schedules, LANL is a research and development facility with great fluctuations in both the types of chemicals emitted and their emission rates. DOE has a program to review new operations for their potential to emit air pollutants.

Table 4–3 Air Pollutant Emissions at LANL in 1999

Pollutant	*LANL Sources Other Than TA-18 and TA-55 (metric tons per year)* [a]	*TA-18 Sources (metric tons per year)*	*TA-55 Sources (metric tons per year)*
Carbon monoxide	24.6	(b)	4.44
Nitrogen dioxide	73.5	(b)	5.97
PM_{10}	3.66	(b)	0.402
Sulfur dioxide	0.474	(b)	0.021

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.

[a] Emissions from the following were included: TA-3 Steam Plant; TA-21 Steam Plant; TA-16 Boilers; TA-48 Boiler; TA-53 Boiler; TA-59 Boiler; paper shredder; TA-3 Asphalt Plant; and TA-54 Water Pump. The inventory did not include various small sources such as residential-size boilers and standby emergency generators.

[b] Emissions from small heating units which burn propane or natural gas are small and are not included in the inventory.

Sources: DOE 1999b, LANL 2000f.

Only a limited amount of monitoring of the ambient air has been performed for nonradiological air pollutants within the LANL region. The New Mexico Environment Department operated a DOE-owned ambient air quality monitoring station adjacent to Bandelier National Monument between 1990 and 1994 to record sulfur dioxide, nitrogen dioxide, ozone, and particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}) levels (see **Table 4–4**). LANL and the New Mexico Environment Department discontinued operation of this station in FY95 because recorded values were well below applicable standards. Beryllium monitoring performed in 1999 at 9 onsite stations, 10 perimeter stations, and 6 regional stations showed that beryllium levels were low. The New Mexico beryllium ambient standard has been repealed.

Table 4–4 Nonradiological Ambient Air Monitoring Results

Pollutant	*Averaging Period*	*Most Stringent Standard* [a] *(micrograms per cubic meter)*	*Ambient Concentration* [b] *(micrograms per cubic meter)*
Sulfur dioxide	Annual	41 [c]	2
	24 hours	205 [c]	18
	3 hours	1,030 [d]	Not applicable
Nitrogen dioxide	Annual	73.7 [c]	4
	24 hours	147 [c]	9
Ozone	1 hour	185 [d]	138
PM_{10}	Annual	50 [d]	8
	24 hours	150 [d]	29

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.

[a] The most stringent of the state and Federal standards are shown.

[b] 1994 ambient concentrations from monitoring site near Bandelier National Monument at TA-49.

[c] State standard.

[d] Federal standard (NAAQS).

Source: DOE 1999b.

Criteria pollutant concentrations attributable to existing LANL activities were estimated for the *LANL SWEIS* and are presented in **Table 4–5**. The concentrations presented are for the Expanded Operations Alternative, which are similar to the *LANL SWEIS* No Action Alternative.

For toxic air pollutants, a bounding analysis was performed for the *LANL SWEIS*, which indicated that the pollutants of concern for exceeding the guideline values at LANL were emissions from the High Explosives Firing Site operations and emissions that contributed to additive risk from all TAs on receptors near the Los Alamos Medical Center. These combined cancer risks were dominated by the chloroform emissions from the Health Research Laboratory. It was shown that pollutants released under the No Action Alternative in the *LANL SWEIS* are not expected to cause air quality impacts that would affect human health and the environment. Although various small quantities of toxic air pollutants are emitted from activities at TA-18, no toxic air pollutant emissions were identified from TA-18 that would be expected to have an adverse air quality impact (LANL 2001a).

Table 4–5 Modeled Ambient Air Concentrations from LANL Sources

Pollutant	*Averaging Period*	*Most Stringent Standard* [a] *(micrograms per cubic meter)*	*Maximum Estimated Concentration* [b] *(micrograms per cubic meter)*
Carbon monoxide	8 hours 1 hour	7,800 11,700	1,440 2,710
Lead	Calendar quarter	1.5	0.00007
Nitrogen dioxide	Annual 24 hours	73.7 147	9 90
PM_{10}	Annual 24 hours	50 150	1 9
Sulfur dioxide	Annual 24 hours 3 hours	41 205 1,030	18 130 254
Total suspended particulates	Annual 24 hours	60 150	2 18

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic PM_{10} mean standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard. Standards and monitored values for pollutants other than particulate matter are stated in parts per million (ppm). These values have been converted to micrograms per cubic meter ($\mu g/m^3$) with appropriate corrections for temperature (21 °C [70 °F]) and pressure (elevation 2,135 meters [7,005 feet), following New Mexico dispersion modeling guidelines (revised 1998) (NMAQB 1998).

[b] Based on the Expanded Operations Alternative in the *LANL SWEIS*. The annual concentrations were analyzed at locations to which the public has access–the site boundary or nearby sensitive areas. Short term concentrations were analyzed at the site boundary and at the fence line of certain technical areas to which the public has short access.

Source: DOE 1999b.

As reported in a special environmental analysis for the Cerro Grande Fire in 2000 (DOE 2000h), there may be some temporary increase in suspended particulate matter as a result of removal of vegetation cover, but air quality would be expected to be within the parameters analyzed in the *LANL SWEIS*.

In accordance with the Clean Air Act, as amended, and New Mexico regulations, the Bandelier National Monument and Wilderness Area have been designated as a Class I area (i.e., wilderness areas that exceed 4,047 hectares [10,000 acres]), where visibility is considered to be an important value (40 CFR 81 and 20 New Mexico Administrative Code 2.74) and requires protection. Visibility is measured according to a standard visual range, i.e., how far an image is transmitted through the atmosphere to an observer some distance away. Visibility has been officially monitored by the National Park Service at the Bandelier National Monument since 1988. The view distance at Bandelier National Monument has been recorded from approximately 77 to 166 kilometers (40 to 103 miles). The visual range has not deteriorated during the period for which data are available.

4.2.3.2 Radiological Releases

Radiological air emissions in 1999 from all LANL TAs are presented in **Table 4–6**. Radiological air emissions from TA-18 and TA-55 are also shown in the table. The airborne releases in 1999 were smaller than the annual projections given in the *LANL SWEIS*. Specifically, for TA-18, the 1999 release of argon-41 was 0.49 curies, compared with the maximum annual projection of 110 curies (see Section 3.2.1); and for

TA-55, the 1999 release of tritium was 1.8 curies, compared with the annual projection of 1,000 curies. The difference in the projected and actual releases are attributable to the fact that the facilities in the areas were operated well below their capacities in 1999.

Table 4–6 Radiological Airborne Releases to the Environment at LANL in 1999[a]

Emission Type	Radionuclide	LANL (curies)	TA-18 (curies)	TA-55 (curies)
Noble gases	Argon-41	14.2	0.49 [b]	—
Airborne particulates	Cobalt-60	3.97×10^{-6}	—	—
	Galluim-68	0.00173	—	—
	Germanium-68	0.00173	—	—
	Arsenic-73	1.83×10^{-5}	—	—
	Arsenic-74	4.49×10^{-5}	—	—
	Selenium-75	3.50×10^{-4}	—	—
	Mercury-197	0.00160	—	—
	Uranium-234/235/238	7.72×10^{-6}	—	7.1×10^{-8}
	Plutonium-238/239/240	2.11×10^{-5}	—	6.3×10^{-8}
	Americum-241	2.78×10^{-6}	—	5.4×10^{-8}
Halogens	Bromine-76	2.32×10^{-4}	—	—
	Bromine-77	1.15×10^{-5}	—	—
	Bromine-82	6.27×10^{-4}	—	—
Nitrogens and oxygens	Nitrogen-13	159	—	—
Tritium and carbons	Tritium (Hydrogen-3)	1,603	—	1.8
	Carbon-11	283 [b]	—	—

[a] Radionuclides with half-lives less than about 10 minutes are not included in the table (e.g., short-lived carbon, oxygen, and nitrogen isotopes). Also, not included are radionuclides for which less than 10^{-6} curies are released per year. Refer to LANL 2000f for the complete list of airborne releases.

[b] Includes nonpoint source emissions of activated air from the Los Alamos Neutron Science Center Facility and TA-18.

Note: Dashed lines indicate virtually no releases.

Source: LANL 2000f.

4.2.4 Noise

Existing LANL-related publicly detectable noise levels are generated by a variety of sources, including truck and automobile movements to and from the LANL TAs, high explosives testing, and security guards' firearms practice activities. Noise levels within Los Alamos County unrelated to LANL are generated predominately by traffic movements and, to a much lesser degree, other residential-, commercial-, and industrial-related activities within the county communities and the surrounding areas. Limited data currently exist on the levels of routine background ambient noise levels, air blasts, or ground vibrations produced by LANL operations that include explosives detonations.

Traffic noise contributes heavily to the background noise heard by humans over most of the county. Although some measurements of sound specifically targeting traffic-generated noise have been made at various county locations in recent studies, these sound levels are found to be highly dependent upon the exact measuring location, time of day, and meteorological conditions. There is, therefore, no single representative measurement of ambient traffic noise for the LANL site. Noise generated by traffic has been computer modeled to estimate the impact of incremental traffic for various studies, including recent NEPA analyses, without demonstrating meaningful change from current levels due to any new activities. While very few measurements of nonspecific background ambient noise in the LANL area have been made, two such measurements have been taken at a couple of locations near the LANL boundaries next to public roadways. Background noise levels were found to range from 31 to 35 decibels A-weighted (dBA) at the vicinity of the entrance to Bandelier National Monument and New Mexico Route 4 (NM 4). At White Rock, background noise levels range from 38 to 51 dBA (one-hour equivalent sound level); this is slightly higher than was found near Bandelier National Monument, probably due to higher levels of traffic and the presence of a residential neighborhood, as well as the different physical setting. The detonation of high explosives represents the peak noise level generated by LANL operations. The results of these detonations are air blasts and ground vibrations.

The primary source of these detonation activities is the high explosives experiments conducted at the LANL Pulsed High-Energy Radiation Machine Emitting X-Rays Facility and surrounding TAs with active firing sites. Within the foreseeable future, the Dual Axis Radiographic Hydrodynamic Test Facility will begin operation (followed by a corresponding reduction of Pulsed High-Energy Radiation Machine Emitting X-Rays Facility operations) and will become a source of high explosives testing. Explosives detonations were performed in March 1995 for the *Dual Axis Radiographic Hydrodynamic Test Facility Final Environmental Impact Statement* (DOE 1995e) analysis, and measurements of air blasts and ground vibrations were obtained for representative Pulsed High-Energy Radiation Machine Emitting X-Rays Facility explosives tests.

Air blasts consist of higher-frequency, audible air pressure waves that accompany an explosives detonation. This noise can be heard by both workers and the area public. The lower-frequency air pressure waves are not audible, but may cause secondary and audible noises within a testing structure that may be heard by workers. Air blasts and most LANL-generated ground vibrations result from testing activities involving above-ground explosives research. The effects of vibration from existing activities at LANL are discussed further in the *LANL SWEIS*.

The forested condition of much of LANL (especially where explosives testing areas are located); the prevailing area atmospheric conditions; and the regional topography that consists of widely varied elevations and rock formations all influence how noise and vibrations can be both attenuated (lessened) and channeled away from receptors. These regional features are jointly responsible for there being little environmental noise pollution or ground vibration concerns to the area resulting from LANL operations. Sudden loud “booming” noises associated with explosives testing are similar to the sound of thunder and may occasionally startle members of the public and LANL workers alike.

Loss of large forest areas from the Cerro Grande Fire in 2000 has had an adverse effect on the ability of the surrounding environment to absorb noise. However, types of noise and noise levels associated with LANL and from activities in surrounding communities have not changed significantly as a result of the fire (DOE 2000h).

Noise generated by LANL operations, together with the audible portions of explosives air blasts, is regulated by county ordinance and worker protection standards. The standard unit used to report sound pressure levels is the decibel (dB); the A-weighted frequency scale (dBA) is an expression of adjusted pressure levels by frequency that accounts for human perception of loudness. Los Alamos County has promulgated a local noise ordinance that establishes noise level limits for residential land uses. Noise levels that affect residential receptors are limited to a maximum of 65 dBA during daytime hours (between 7 a.m. and 9 p.m.) and 53 dBA during nighttime hours (between 9 p.m. and 7 a.m). Between 7 a.m. and 9 p.m., the permissible noise level can be increased to 75 dBA in residential areas, provided the noise is limited to 10 minutes in any one hour. Activities that do not meet the noise ordinance limits require a permit.

The Los Alamos County Community Development Department has determined that LANL does not need a special permit under the Los Alamos County Code because noise related to explosives testing is not prolonged, nor is it considered unusual to the Los Alamos community.

Traffic noise from truck and automobile movements around the LANL TAs is excepted under Los Alamos County noise regulations, as is the traffic noise generated along public thoroughfares within the county.

The vigor and well being of area wildlife and sensitive, federally protected bird populations suggest that these environmental conditions are present at levels within an acceptable tolerance range for most wildlife species and sensitive nesting birds found along the Pajarito Plateau.

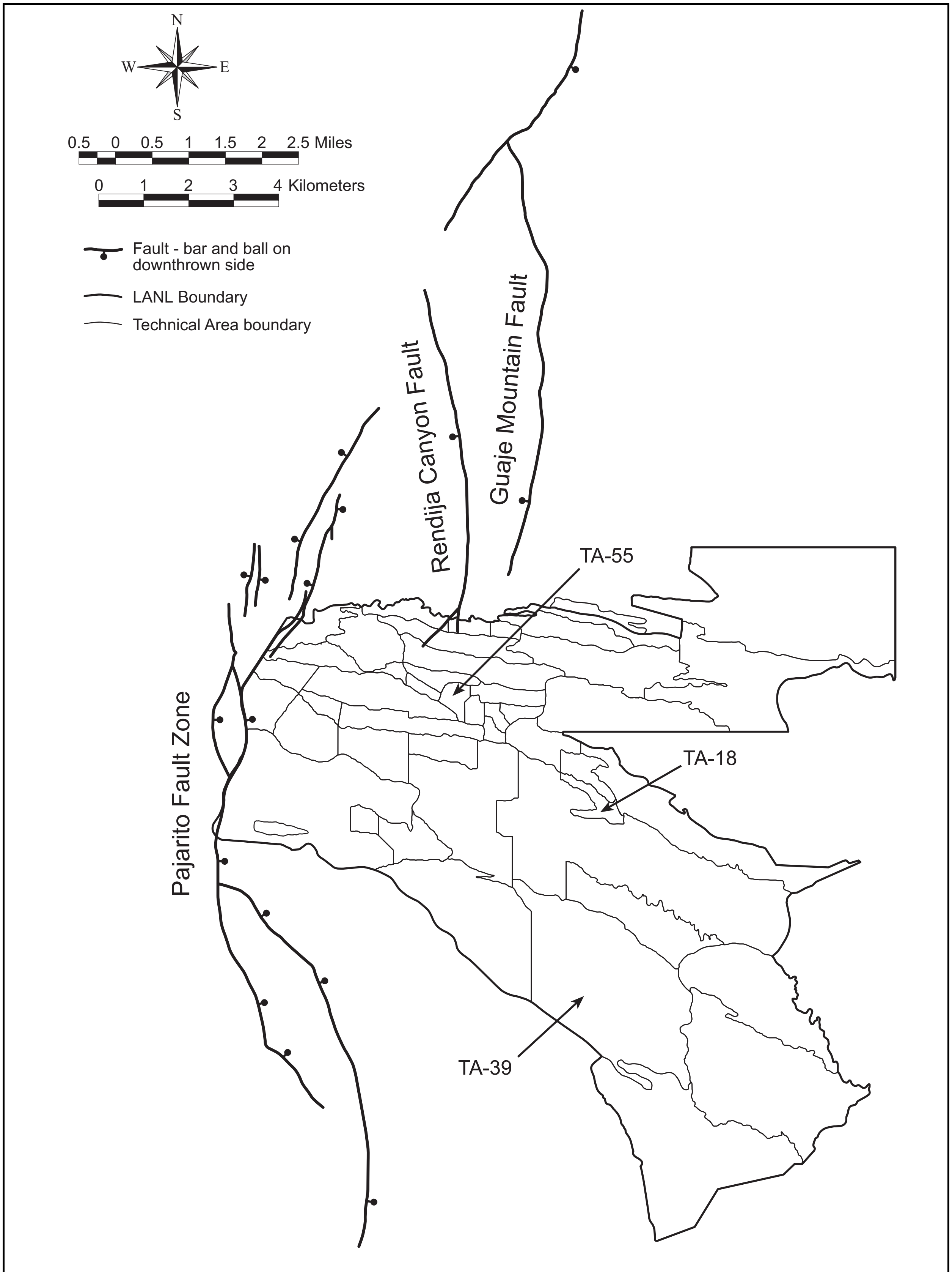
4.2.5 Geology and Soils

LANL is located on the Pajarito Plateau within the Southern Rocky Mountains Physiographic Province. The Pajarito Plateau lies between the Sierra de Los Valles and the Jemez Mountains to the west and the Rio Grande to the east. The surface of the Pajarito Plateau is divided into numerous narrow, finger-like mesas separated by deep east-to-west-oriented canyons that drain toward the Rio Grande. A primary geologic feature in the region is the Rio Grande Rift, which begins in northern Mexico, trends northward across central New Mexico, and ends in central Colorado. The rift is a complex system of north-trending basins that have formed by downfaulting of large blocks of the Earth's crust. In the Los Alamos area, the Rio Grande Rift is about 56 kilometers (35 miles) wide and encompasses the Española Basin. The Sangre de Cristo Mountains border the Rio Grande Rift on the east, and the Jemez Mountains lie over the western fault margin of the rift. The north-trending Pajarito Fault system is part of the Rio Grande Rift and consists of a group of interconnecting faults that are nearly parallel.

In summary, the rocks present in the LANL region were predominantly produced by volcanic and sedimentary processes. The Pajarito Plateau is capped by the Bandelier Tuff. This unit attains a thickness of more than 200 meters (700 feet) in the LANL region and consists of ash-flow deposits of rhyolitic tuff and pumice, erupted between about 1.2 and 1.6 million years ago during the early to middle Quaternary period (i.e., Pleistocene) from the Valles and Toledo calderas located in the Jemez Mountains volcanic field (located west of LANL). Older, underlying units include the Puye Formation, which is a sedimentary unit comprised from materials derived from the Jemez Mountains and the ancestral Rio Grande and intruded in places by Cerros del Rio basalt flows. Underlying it is the Tschicoma Formation which consists of volcanic vent deposits. The Santa Fe Group is the most extensive unit in the Rio Grande Rift and largely consists of sedimentary materials and rocks including evaporites derived from stream or deltaic deposits, but also contains volcanic tuff deposits and basalts. The Sante Fe Group sits atop Precambrian age (greater than 570 million years old) crystalline basement rock. Additional details about LANL site geology are presented in the *LANL SWEIS*.

There are no active mines, mills, pits, or quarries in Los Alamos County or on DOE land at LANL. However, rock and mineral resources including sand, gravel, and volcanic pumice are mined throughout the surrounding counties. Sand and gravel are primarily used in construction, including for road building, and pumice is used in textile laundries to soften material and as an abrasive, as well as for building blocks and in landscaping. The major sand and gravel deposit in the area is located in the lower member of the Puye Conglomerate. The welded and moderately welded units of the Bandelier Tuff are suitable as foundation rocks, structural and ornamental stone, or insulating material. Volcanic tuff has also been used successfully as aggregate in soil-cement subbases for roads.

The nearby north-trending Pajarito Fault system dominates the geologic structure of the LANL area. The Pajarito Fault system consists of three major faults and numerous secondary faults. The major faults in Los Alamos County are the Pajarito, Rendija Canyon, and Guaje Mountain (see **Figure 4–4**). Estimates of the most recent movements along the faults are based on trench studies where the faults are not buried. The estimates of movement range from as recent as 4,000 years ago for the Guaje Mountain Fault to 55,000 years ago for the Pajarito Fault, with estimated movement along the Rendija Canyon Fault occurring between 8,000



Source: DOE 1999b.

Figure 4–4 Major Faults at LANL

and 23,000 years ago. It is possible that the most recent movements along the faults are younger than those presented. Therefore, these faults should be considered active and capable per the U.S. Nuclear Regulatory Commission definition of the term as used for seismic safety. A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years, or recurrent movement within the past 500,000 years (10 CFR Part 100, Appendix A). Additional detail on ongoing seismic studies and their implications can be found in the *LANL SWEIS* and supplemental analyses that considered the seismic setting at TA-55.

LANL is located in a region of generally low to moderate seismicity overall. A historical catalog has been compiled of earthquakes that have occurred in the LANL area from 1873 to 1991. Only six of these have had estimated magnitudes of 5 or greater on the Richter scale. The May 1918 Cerrillos Earthquake was the most significant seismic event in this period. This earthquake had an estimated Richter magnitude of 5.5 and was centered approximately 31 miles (50 kilometers) southeast of LANL. This event had a reported Modified Mercalli Intensity of VII at its epicenter. Within a radius of 100 kilometers (62 miles) of central LANL, a total of five significant earthquakes (i.e., having a magnitude of at least 4.5 or a Modified Mercalli Intensity of VI or larger) have been documented, including the May 1918 event (USGS 2001b). Since 1973, six earthquakes have been recorded within 100 kilometers (62 miles) of central LANL ranging in magnitude from 1.6 to a magnitude 4.5 event in March 1973. This 1973 earthquake was the closest to LANL at 28 kilometers (16 miles) to the northeast. The most recent was a magnitude 2.8 earthquake that occurred in December 1998 at a distance of 86 kilometers (53 miles) (USGS 2001a).

Earthquake hazard results indicate that the Pajarito Fault system represents the greatest potential risk to LANL, with an estimated maximum earthquake magnitude of about 7. Although large uncertainties exist, an earthquake with a Richter magnitude greater than or equal to 6 is estimated to have an annual probability of occurrence of 1 in 4,000 (i.e., once every 4,000 years); an earthquake with a magnitude greater than or equal to 7 is estimated to have an annual probability of occurrence of 1 in 100,000 along the Pajarito Fault system. The hazard study of facilities in eight LANL TAs found that earthquakes having an annual probability of occurrence of 1 in 10,000 would cause a horizontal peak ground acceleration ranging from 0.53 to 0.57. Measures of peak (ground) acceleration indicate what an object on the ground would experience during an earthquake. This motion is customarily expressed in units of g (gravitational acceleration). Maintenance and refurbishment activities at LANL are specifically intended to upgrade the seismic performance of older structures. For reference, a comparison of Modified Mercalli Intensity (the observed effects of earthquakes) with measures of earthquake magnitude and ground acceleration is provided in Section F.5.2 (see Appendix F).

While peak acceleration is generally adequate to approximate what a short structure would experience in terms of horizontal force during an earthquake, it does not account for the range of energies experienced by a building during an earthquake, particularly for taller buildings. Thus, building design based on peak acceleration alone does not provide a uniform margin against collapse. However, the U.S. Geological Survey has developed new seismic hazard metrics and associated National Earthquake Hazard Reduction Program maps that are based on response spectral acceleration (spectral acceleration).

Spectral acceleration accounts for the natural period of vibration of structures (i.e., short buildings have short natural periods [up to 0.6 seconds] and taller buildings longer periods [0.7 seconds or longer]) (USGS 2001j). The National Earthquake Hazard Reduction Program maps have been adapted for use in the new *International Building Code* (ICC 2000), and depict maximum considered earthquake ground motion of 0.2- and 1-second spectral response acceleration, respectively, based on a 2 percent probability of exceedance in 50 years. This corresponds to an annual recurrence interval of about 1 in 2,500. The central portion of LANL (encompassing TA-18 and TA-55) is calculated to lie within the 0.57 g to 0.58 g mapping contours for a 0.2-second spectral response acceleration and the 0.18 g to 0.19 g contours for a 1-second spectral response acceleration. For comparison, the calculated peak ground acceleration for the given probability of exceedance is approximately 0.25 g (USGS 2001e).

Volcanism in the Jemez Mountains volcanic field, west of LANL, has a 13-million-year history. The Bandelier Tuff is the material upon which most LANL facilities are constructed. The Bandelier Tuff is generally thickest to the west of LANL near its source, and thins eastward across the Pajarito Plateau, due to increasing distance from the source and erosion. Volcanic eruptions continued up to about 520,000 years ago, followed by a 460,000-year period of dormancy. The most recent volcanic activity produced several rock units, including the El Cajete pumice, which is a minor unit in the LANL area that overlays the Bandelier Tuff. The El Cajete pumice dates at 50,000 to 60,000 years old. Recurrence intervals for future volcanism have not been established.

Facilities near a cliff edge or in a canyon bottom are potentially susceptible to slope instability and specifically are susceptible to the geologic hazards of rockfalls and landslides. Slope stability studies have been performed at these and other facilities where a hazard has been identified. As for other geologic hazards, the potential for land subsidence and soil liquefaction at LANL is considered low.

Several distinct soils have developed in Los Alamos County as a result of interactions between the bedrock, topography, and local climate. Most soils developed from acidic volcanic rock and range in texture from clay and clay loam to gravel. Rock outcrops are common occurring on greater than 50 percent of the surface (DOE 1996g). Soils that formed on mesa tops are well drained and range from very shallow (0 to 25 centimeters [0 to 10 inches]) to moderately deep (51 to 102 centimeters [20 to 40 inches]), with the greatest depth to the underlying Bandelier Tuff being 102 centimeters (40 inches). Soil erosion rates vary considerably on the mesa tops at LANL, with the highest rates occurring in drainage channels, where roads and structures concentrate runoff, and in areas of steep slopes and the lowest rates occurring on gently sloping portions of the mesa tops away from the channels. A recent study suggested that erosion rates are high across widespread portions of local pinyon-juniper woodlands, which are found on the eastern portion of LANL. High erosion rates appear to be relatively recent, most likely resulting from loss of vegetative cover, decreased precipitation, past logging practices, and past livestock grazing (DOE 1999b). Site soils are acceptable for standard construction techniques. No prime farmland soils have been designated in Los Alamos County (DOE 1996f).

The recent Cerro Grande Fire has increased the potential for soil erosion across areas burned at LANL due to the loss of vegetation and has also destabilized rocks close to the edges of mesas, mesa side slopes, and canyon bottoms. While the postburn assessment conducted by the U.S. Forest Service Burn Area Emergency Rehabilitation Team found that the Cerro Grande Fire created hydrophobic (water repellent) soil conditions, resulting in an increased runoff rate along rather appreciable tracts of land located just to the northwest of LANL, no significant areas of hydrophobic soils were found within LANL. These effects are expected to persist for some three to five years (DOE 2000h).

TA-18 is located approximately 5.3 kilometers (3.3 miles) southeast of the mapped terminating point of the Rendija Canyon Fault (see Figure 4–4). This fault is the nearest capable fault to TA-18. Typical subsurface stratigraphy at LANL and TA-18 consists of welded and poorly welded volcanic tuffs that comprise the Tshirege Member of the Bandelier Tuff Formation. The Tshirege Member attains a thickness of about 122 meters (400 feet) (DOE 1995e). Site-specific investigations in Pajarito Canyon near TA-18 have found the tuff to be highly weathered and unwelded, with the upper 3 to 4.5 meters (10 to 15 feet) of the material classified as clayey sand or sandy clay. However, surrounding cliff faces consist of welded tuff exhibiting vertical jointing. The canyon tuff is overlain by up to 4.5 meters (15 feet) of sandy and silty alluvium (URS 2000). Soils derived from these deposits are typically sandy loams (DOE 1995e). In general, sandy soils occurring where the water table or perched water bodies lie near the surface present a potential for liquefaction.

TA-55 is located just to the southwest of the southern terminus of Rendija Canyon Fault, which is located about 1.3 kilometers (0.8 miles) northwest of the facility. Site stratigraphy is generally expected to be similar to that described above for TA-18, except that the thickness of overlying alluvium is thinner.

4.2.6 Water Resources

4.2.6.1 Surface Water

Surface water in the Los Alamos area occurs primarily as short-lived or intermittent reaches of streams (i.e., arroyos). Perennial springs on the flanks of the Jemez Mountains supply base flow into the upper reaches of some canyons, but the volume is insufficient to maintain surface flows across the LANL site before they are depleted by evaporation, transpiration, and infiltration. Runoff from heavy thunderstorms or heavy snowmelt reaches the Rio Grande, the major river in north-central New Mexico, several times a year in some drainages. Effluent from sanitary sewage, industrial water treatment plants, and cooling-tower blowdown enter some canyons at rates sufficient to maintain surface flows for varying distances. Major watersheds in the LANL region are shown in **Figure 4–5**. All of these watersheds are tributaries to an 18-kilometer (11-mile) segment of the Rio Grande between Otowi Bridge and Frijoles Canyon. The Rio Grande passes through Cochiti Lake, approximately 18 kilometers (11 miles) below Frijoles Canyon. The Los Alamos Reservoir, in upper Los Alamos Canyon, has a capacity of 51,000 cubic meters (41 acre-feet). The reservoir water is used for recreation, swimming, fishing, and landscape irrigation in the Los Alamos town site. The Pajarito Plateau Canyons, which serve as collection points for the regional watersheds, originate either along the eastern rim of the Sierra de Los Valles or on the Pajarito Plateau. Within LANL boundaries, only Los Alamos, Pajarito, Water, Ancho, Sandia, Pueblo, and Chaquehui Canyons contain reaches or streams with sections that have continuous flow. Intermittent streams within LANL property are not classified, but are protected by the State of New Mexico for livestock watering and wildlife habitat use (New Mexico Administrative Code 20.6.4.10). Surface water within LANL boundaries is not a source of municipal, industrial, or irrigation water, but is used by wildlife that live within, or migrate through, the region.

Most of LANL effluent is discharged into normally dry arroyos, and LANL is required to meet effluent limitations under the National Pollutant Discharge Elimination System (NPDES) permit program that requires routine effluents monitoring. Therefore, the water quality of the intermittent streams is more characteristic of the quality of these discharges than of natural runoff, as reflected in the results of 1999 surface water and runoff monitoring. LANL's current NPDES permit (No. NM0028355), which was reissued in December 2000, covers all onsite industrial and sanitary effluent discharges, and DOE and the University California are co-permittees. As a result of an outfall reduction program, the number of outfalls requiring monitoring under the permit was reduced from 36 (including 1 sanitary outfall from the Sanitary Wastewater Systems Facility and 35 industrial wastewater outfalls) to 21 in the recently reissued permit. This reduction was achieved by removing process flows for 7 industrial outfalls and completing the lease transfer of the drinking water system, including 9 associated outfalls, to Los Alamos County. During 1999, permit compliance was determined from analysis of 1,250 industrial outfall samples and 175 samples from the Sanitary Wastewater Systems Facility (Outfall 13S) for such parameters as metals, radionuclides, and convention parameters (e.g., pH, total suspended solids, etc.). Monitoring results are submitted to EPA and to the New Mexico Environment Department. The NPDES permit compliance rate for all discharge points was 98.9 percent, with a total of 16 industrial outfall samples exceeding permit limits (LANL 2000f). Industrial and sanitary effluent management is discussed further in Section 4.2.12.5.

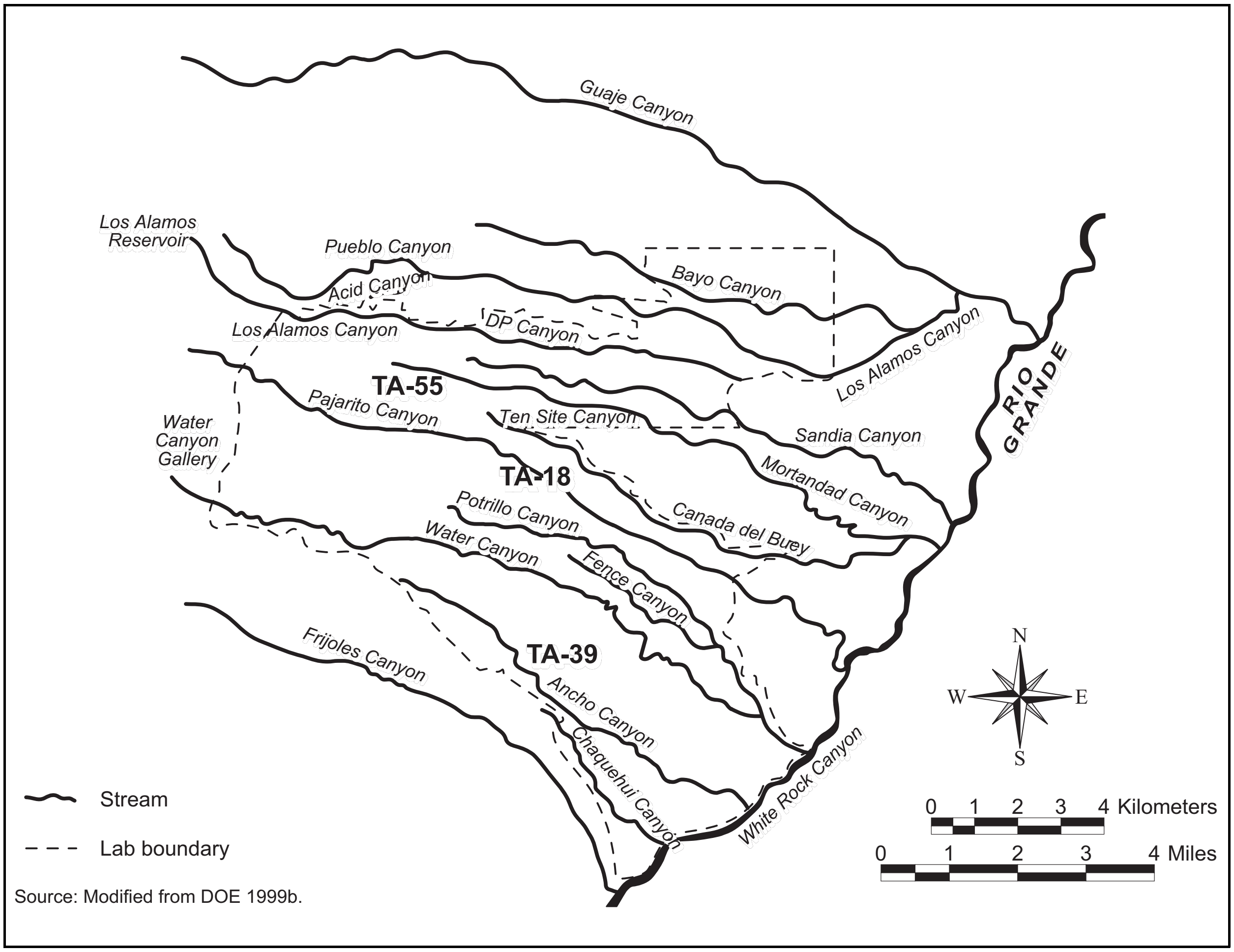


Figure 4–5 Surface Water Features at LANL

LANL also operated under seven NPDES stormwater discharge permits in 1999, including six issued for construction activities and one multisector general permit for stormwater discharges associated with industrial activity for which DOE and the University of California are also co-permittees. As required under this general permit, LANL performed stormwater monitoring in 1999 and developed and implemented 22 storm-water pollution prevention plans for its industrial activities (LANL 2000f).

LANL monitors surface waters from regional and Pajarito Plateau stations to evaluate the environmental effects of facility operations. Historical activities and resulting effluent discharges have affected water courses and associated sediments particularly in Acid, Pueblo, Los Alamos, and Mortandad Canyons and, consequently, continue to affect surface water and runoff quality in these areas (LANL 2000f). Surface water grab samples are collected annually from locations where effluent discharges or natural runoff maintains stream flow. Runoff samples are also collected and, since 1996, they have been collected using stream gaging stations, some with automated samplers. Samples are collected when a significant rainfall event causes flow in a monitored portion of a drainage. Many runoff stations are located where drainages cross the LANL boundaries. Detailed information on surface water and stormwater runoff monitoring including analytical results are contained in the annual site environmental report (LANL 2000f).

Among the environmental effects produced by the Cerro Grande Fire was an increased potential for stormwater runoff through the canyons that cross LANL property as a result of the loss of vegetation and soil organic matter. It is expected that soil erosion rates and corresponding sediments loads in runoff from denuded watersheds will be much higher than prefire levels for many years resulting in the potential for sediment and debris-laden runoff to reach the Rio Grande. It is also likely that runoff and ambient water quality in canyon drainages will be temporarily reduced by the increase in suspended sediment and by the liberation of organic nitrogen from fire-burned soils, the latter of which can also impact shallow groundwater (DOE 2000h).

DOE has delineated all 100-year floodplains within LANL boundaries, which are generally associated with canyon drainages. There are a number of structures within the 100-year floodplain. Most may be characterized as small storage buildings, guard stations, well heads, water treatment stations, and some light laboratory buildings. There are no waste management facilities in the 100-year floodplain. Some facilities are characterized as "moderate hazard" due to the presence of sealed sources or x-ray equipment, but most are designated "low hazard" or "no hazard". The 500-year floodplain has been designated for Los Alamos Canyon. Overall, most laboratory development is on mesa tops, and development within canyons is light (DOE 2000h). Nevertheless, for practical purposes the Cerro Grande Fire has increased the extent of all delineated floodplains in and below burned watershed areas (i.e., predominantly Los Alamos, Sandia, Mortandad, Pajarito, and Water Canyons) due to vegetation loss. This will allow more stormwater runoff to reach the canyon bottoms and could subject LANL facilities located within or near the prefire delineated floodplain areas to increased erosion or sediment and debris deposition (DOE 2000h).

TA-18 contains no permanent, natural, surface water bodies, and the reach of the Pajarito Canyon near the developed area is not perennial. Portions of the facility complex, including the SHEBA building, are located within the 100-year floodplain associated with Pajarito Canyon. TA-18 is located at the confluence of Pajarito and Three Mile Canyons. These watersheds were among those impacted by the Cerro Grande Fire, which substantially increased the postburn peak runoff flow rate in the canyons. For Pajarito Canyon at TA-18, hydrologic modeling indicates that the peak flow for stormwater runoff from the 6-hour, 100-year storm has increased from a pre-burn rate of 4.13 cubic meters per second (146 cubic feet per second) to an estimated 70.6 cubic meters per second (2,492 cubic feet per second) (DOE 2000h). Nevertheless, DOE has taken steps to ensure that the facility is protected from flooding associated with the postfire 100-year storm. This has included the construction of additional structural controls including a new flood retention structure upstream from the facility, a trash rack to retain flood debris, excavated flow channel, and installation of metal sheet piling to divert floodwaters and to protect individual structures from flood-propelled projectiles (LANL 2000c).

TA-55 contains no permanent, natural surface water bodies and the developed areas are not located within a delineated floodplain.

4.2.6.2 Groundwater

Groundwater in the Los Alamos area occurs as perched groundwater near the surface in shallow canyon bottom alluvium and at deeper levels in the main (regional) aquifer (LANL 2000f). Most aquifers underlying LANL and vicinity, except for perched groundwater bodies, are considered Class II aquifers (i.e., those currently used or potentially available for drinking water or other beneficial use). Alluvial groundwater bodies within LANL boundaries have been primarily characterized by drilling wells on a localized basis where LANL operations are conducted. Wells in Mortandad, Los Alamos, Pueblo, and Pajarito Canyons and in Cañada del Buey indicate the presence of continually saturated alluvial groundwater bodies. Intermediate perched groundwater bodies of limited extent are known to occur within the conglomerates and basalts beneath the alluvium in portions of Pueblo, Los Alamos, and Sandia Canyons; in volcanic rocks on the sides of the Jemez Mountains to the west of LANL, from which it discharges at spring heads; and on the western portion of the Pajarito Plateau (LANL 2000f).

The locations and extent of perched groundwater bodies have not been fully characterized at LANL, but investigations are continuing, and unidentified perched aquifers may exist. The depth to perched groundwater from the surface ranges from approximately 27 meters (90 feet) in the middle of Pueblo Canyon to about 137 meters (450 feet) in lower Sandia Canyon. The regional aquifer exists in the sedimentary and volcanic rocks of the Española Basin, with a lateral extent from the Jemez Mountains in the west to the Sangre de Cristo Mountains in the east (see **Figure 4–6**). The hydrostratigraphic (water-bearing) units comprising the regional aquifer include the interconnected Puye Formation and the Tesuque Formation of the Santa Fe Group, with the top of the aquifer originating in the Cerros del Rio Formation, rather than in the Puye Formation, in some locations. Groundwater flow paths are conceptually illustrated in Figure 4–6. Groundwater flow is generally to the east.

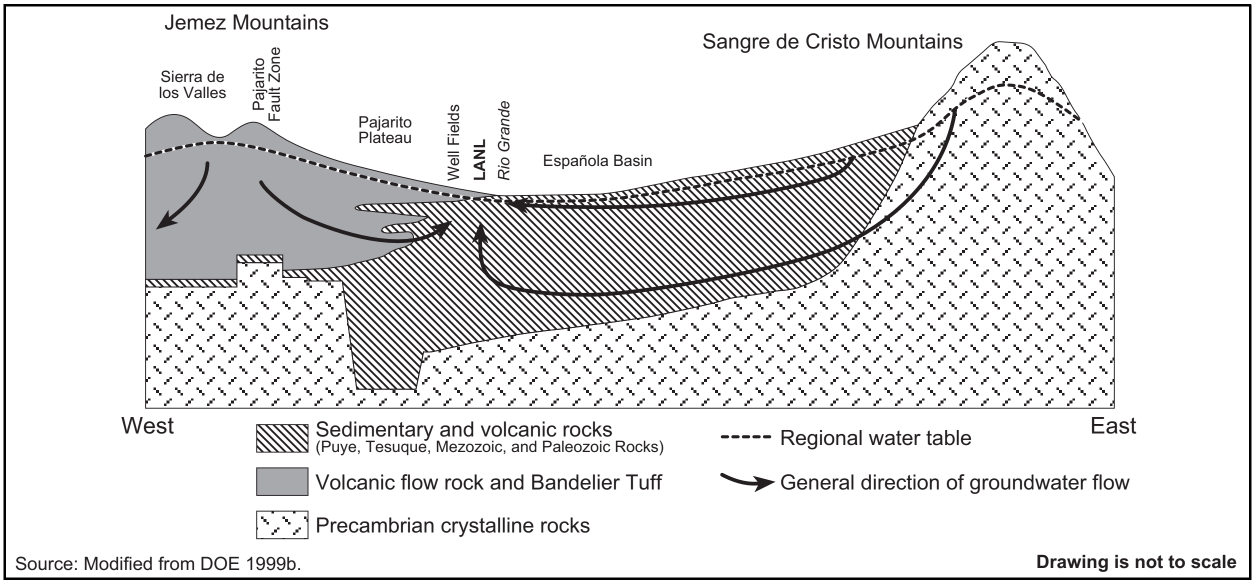


Figure 4–6 Hydrogeology of the Española Portion of the Northern Rio Grande Basin

The regional aquifer is hydraulically separated for practical purposes from the overlying alluvial and intermediate perched groundwater bodies by unsaturated volcanic tuff and sedimentary strata, with the regional water table surface lying at a depth below land surface that varies from approximately 366 meters (1,200 feet) along the western boundary of the Pajarito Plateau to approximately 183 meters (600 feet) along its eastern edge. Thus, these hydrogeologic conditions tend to insulate the regional aquifer from near-surface waste management activities. Water in the regional aquifer is under artesian conditions under the eastern part of the Pajarito Plateau near the Rio Grande.

Recharge of the regional aquifer has not been fully characterized and sources are uncertain; data suggest that the regional aquifer of the Española Basin is not strongly interconnected across its extent. Recent investigations further suggest that the majority of water pumped to date has been from storage, with minimal recharge of the regional aquifer. While the regional aquifer is present beneath all watersheds across the LANL region, it is also generally considered to receive negligible recharge from surface water streams in the watersheds. Springs in the LANL area originate from alluvial and intermediate perched groundwater bodies and the regional aquifer and occur in the Guaje, Pueblo, Los Alamos, Pajarito, Frijoles, and White Rock Canyon watersheds. In particular, 27 springs discharge from the regional aquifer into White Rock Canyon. A perched aquifer yields a relatively high flow to a former potable water supply gallery in Water Canyon (LANL 2000f).

Short-term effects of last year's Cerro Grande Fire on LANL groundwater resources include a potential increase in the prevalence of perched groundwater and springs. Also, as discussed for surface water, the liberation of organic nitrogen from burned soils could impact shallow groundwater in the perched and alluvial zones although the effects on deeper groundwater resources are not known (DOE 2000h).

Groundwater monitoring is conducted within and near LANL and encompasses the alluvial zone, intermediate perched groundwater zone, regional aquifer, and springs. However, although largely insulated from effects resulting from surface activities by hydrogeologic conditions, resource management and protection efforts are focused on the regional aquifer, which is the water supply source for the Los Alamos public water supply. The groundwater monitoring network for alluvial groundwater consists of shallow observation wells located in Mortandad, Los Alamos, Pueblo, and Pajarito Canyons and in Cañada del Buey. Perched groundwater is monitored from two test wells and one spring (i.e., the Water Canyon Gallery). The monitoring network for the regional aquifer includes 8 deep test wells completed by the U.S. Geological Survey, 13 deep supply wells that produce water for all of LANL and the surrounding communities, and from numerous springs, including those in White Rock Canyon (LANL 2000f).

As previously indicated, canyon bottom alluvial groundwater in Pueblo, Los Alamos, and Mortandad Canyons receives effluent and has been affected by it. Most notably, Mortandad Canyon groundwater samples during 1999 exceeded or approached the New Mexico groundwater standards for fluoride and nitrate. The nitrate source is nitric acid from plutonium processing at TA-55 that enters the TA-50 waste stream. However, corrective action measures instituted at the Radioactive Liquid Waste Treatment Facility have had a positive impact on nitrogen waste discharges and associated groundwater concentrations. Detailed information on groundwater monitoring, including analytical results, is presented in the annual site environmental report (LANL 2000f).

The main aquifer is the only body of groundwater in the region that is sufficiently saturated and permeable to transmit economic quantities of water to wells for public use. All drinking water for Los Alamos County, LANL, and Bandelier National Monument comes from the main aquifer. Water use is detailed in Section 4.2.2.4.

TA-18 is immediately underlain by alluvial groundwater. The depth to the regional aquifer beneath the site is approximately 261 meters (855 feet) and the flow is expected to be to the southeast (LANL 2001a).

The depth to groundwater beneath TA-55 is approximately 390 meters (1,280 feet) and the flow is expected to be to the east and southeast (LANL 2001a). As discussed above, effluent from TA-55 is conveyed through the TA-50 wastewater treatment facility and then discharged to Mortandad Canyon.

4.2.7 Ecological Resources

4.2.7.1 Terrestrial Resources

LANL lies within the Colorado Plateau Province. Ecosystems within the laboratory site itself are quite diverse, due partly to the 1,525-meter (5,000-foot) elevational gradient from the Rio Grande on the southeastern boundary to the Jemez Mountains, 20 kilometers (12.4 miles) to the west, and to the many canyons with abrupt slope changes that dissect the site. Only a small portion of the total land area at LANL has been developed (DOE 1996g). In fact, only 5 percent of the site is estimated to be unavailable to most wildlife (because of security fencing). The remaining land has been classified into six major vegetation zones, which are defined by the dominant plants present, and occur within specific elevational zones (see **Figure 4–7**). Ponderosa pine forest, pinyon-juniper woodland, and juniper savannah each occur on the site. Mixed conifer forests (including spruce fir and montane grassland), which occur at higher elevations to the

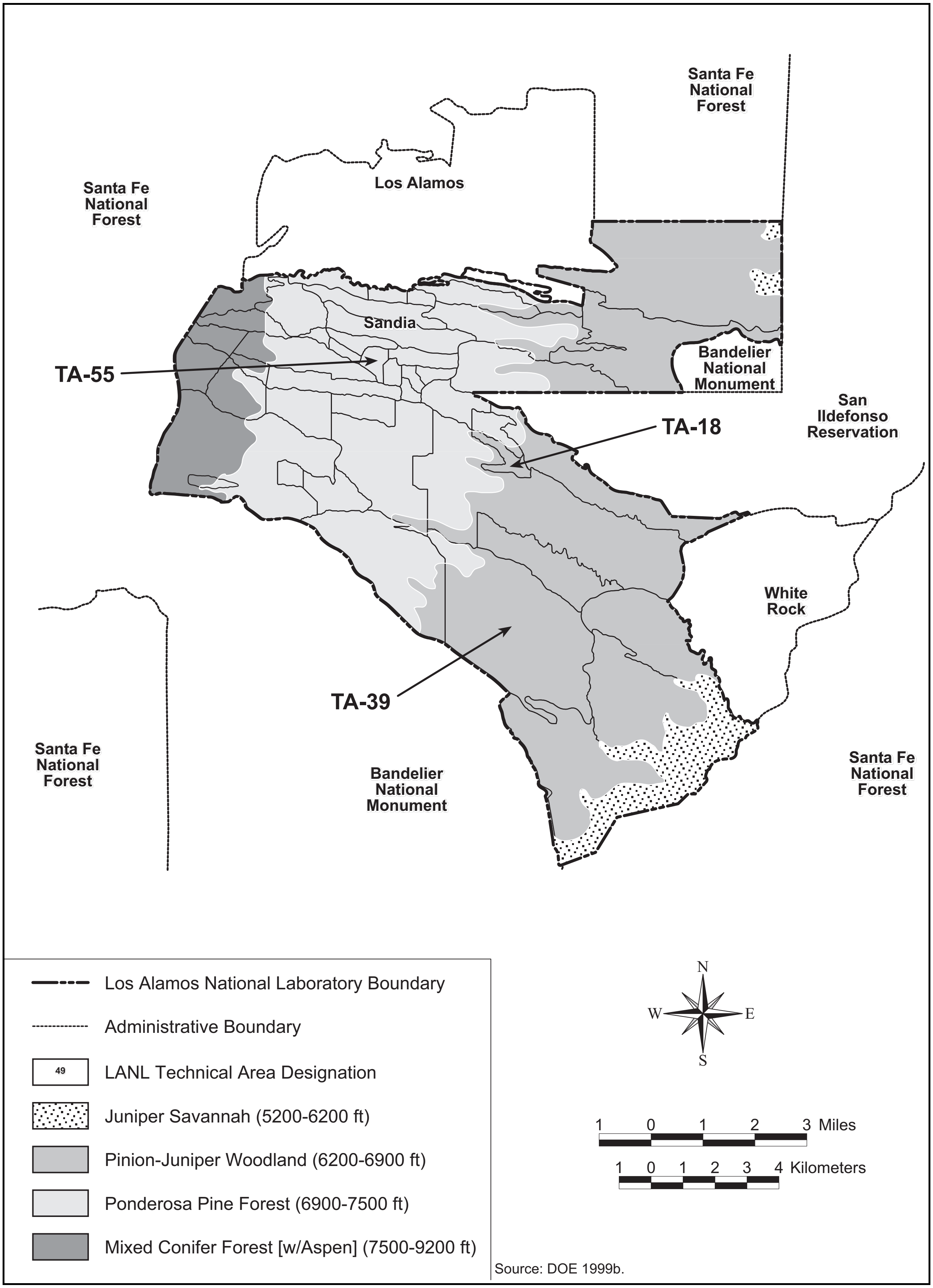


Figure 4–7 LANL Vegetation Zones

4.2.7.2 Wetlands

A 1996 field survey identified an estimated 20 hectares (50 acres) of wetlands within LANL. The LANL survey determined that more than 95 percent of the identified wetlands are located in the Sandia, Mortandad, Pajarito, and Water Canyon watersheds.

Wetlands in the general LANL region provide habitat for reptiles, amphibians, and invertebrates (e.g., insects), and potentially contribute to the overall habitat requirements of a number of Federal- and state-listed species. The majority of the wetlands in the area are associated with canyon stream channels or are present on mountains or mesas as isolated meadows containing ponds or marshes, often in association with springs or seeps. There are also some springs bordering the Rio Grande within White Rock Canyon. Cochiti Lake, located downstream from LANL, supports lake-associated wetlands.

Currently, about 5 hectares (13 acres) of wetlands within LANL boundaries are caused or enhanced by process effluent wastewater from 21 NPDES-permitted outfalls. These artificially created wetlands are afforded the same legal protection as wetlands that stem from natural sources. In 1996, the effluent from NPDES outfalls, both storm water and process water, contributed 108 million gallons (407 million liters) to wetlands within LANL boundaries, and nearly half of the outfalls are probable sources of drinking water for large mammals.

During the Cerro Grande Fire, 6.5 hectares (16 acres), or 20 percent of the wetlands occurring on LANL, were burned at a low or moderate intensity. No wetlands within LANL were severely burned. Secondary effects from the fire to wetlands may also occur as a result of increased runoff due to the loss of vegetation. Wetlands were not disturbed by fire suppression activities; however, a number of projects were undertaken after the Cerro Grande Fire to control runoff and erosion. Two projects involving the enlargement of culverts in lower Pajarito Canyon, one about 0.4 kilometers (0.25 miles) downstream from TA-18 and the other at State Road 4, resulted in removal of about 0.6 hectares (1.5 acres) of wetland vegetation composed primarily of willow trees. Wetland vegetation is likely to regenerate over the next several years if the area is not silted in or scoured away by floodwaters (DOE 2000h).

There is one wetland located at the eastern end of TA-18. This wetland results from manmade sources and is characterized by riparian vegetation. Wetland plant species present include rush, willow, and broad-leafed cattail. Animals observed using this wetland include the many-lined skink, western chorus frog, red-winged blackbird, violet-green swallow, long-tailed vole, and vagrant shrew.

There are three wetlands located within TA-55. These wetlands result from natural sources and are characterized by vegetation and faunal components similar to those found in the wetland associated with TA-18.

4.2.7.3 Aquatic Resources

While the Rito de Los Frijoles in Bandelier National Monument (located to the south of LANL) and the Rio Grande are the only truly perennial streams in the region. Several of the canyon floors on LANL contain reaches of perennial surface water, such as the perennial streams draining lower Pajarito and Ancho Canyons to the Rio Grande. Surface water flow occurs in canyon bottoms seasonally, or intermittently, as a result of spring snowmelt and summer rain. A few short sections of riparian vegetation of cottonwood, willow, and other water-loving plants are present in scattered locations on LANL, as well as along the Rio Grande in White Rock Canyon. The springs and streams at LANL do not support fish populations; however, many other aquatic species thrive in these waters (DOE 1996g). Terrestrial wildlife use onsite streams for drinking and associated riparian habitat for nesting and feeding.

There are no aquatic resources located in either TA-18 or TA-55.

4.2.7.4 Threatened and Endangered Species

There are four agencies that have authority to designate threatened, endangered, and sensitive species in New Mexico. The agencies are the U.S. Fish and Wildlife Service (USFWS), the New Mexico Game and Fish Department, the New Mexico Forestry and Resource Conservation Division, and the U.S. Forest Service. The State of New Mexico separates the regulatory authority for plants and animals between the Forestry and Resource Conservation Division and the Game and Fish Department, respectively. The U.S. Forest Service lists species for special management consideration on lands under their jurisdiction and protects these species under the authority of the Endangered Species Act of 1973.

A number of regionally protected and sensitive (rare or declining) species have been documented in the LANL region (see **Table 4–7**). These consist of 2 federally endangered species (the whooping crane and southwestern willow flycatcher), 2 federally threatened species (the bald eagle and Mexican spotted owl), and 18 species of concern (species that may be of concern to USFWS but do not receive recognition under the Endangered Species Act, and that the USFWS encourages agencies to include in NEPA studies). Species listed as endangered threatened, rare, or sensitive by the State of New Mexico are also included in Table 4–7. The New Mexico "sensitive" taxa are those taxa that deserve special consideration in management and planning, and are not listed as threatened or endangered by the State of New Mexico. In addition, critical habitat for the threatened Mexican spotted owl has been designated on Santa Fe National Forest lands that are contiguous with LANL's western boundary.

As mentioned in Section 4.2.7.2, there is one wetland at TA-18. Threatened and endangered species and species of concern that are associated with this type of wetland and which may be found in the vicinity include the Northern goshawk which is listed as a species of concern, the federally threatened Mexican spotted owl, the state threatened spotted bat, the Federally endangered southwestern willow flycatcher, and the checkered lily, which is also listed as a species of concern.

There are three wetland locations within TA-55. These wetlands are similar in vegetation and components to the one at TA-18 and therefore the same threatened and endangered species and species of concern may be found in the vicinity of any of the wetlands within TA-55.

In addition, both TA-18 and TA-55 contain core and buffer Areas of Environmental Interest for the Mexican spotted owl. Areas of Environmental Interest are established under LANL's Habitat Management Plan (LANL 1998) and are areas within LANL that are being managed and protected because of their significance to biological or other resources. Habitats of threatened and endangered species that occur or may occur at LANL are designated as Areas of Environmental Interest. In general, an Area of Environmental Interest consists of a core area that contains important breeding or wintering habitat for a specific species and a buffer area around the core area. The buffer protects the area from disturbances that would degrade the value of the core area to the species.

The results of the Cerro Grande Fire likely will not cause a long-term change to the overall number of federally listed threatened and endangered species inhabiting the region. However, the results of the fire likely will change the distribution and movement of various species, including the Mexican spotted owl. The areas off LANL that have been proposed as critical habitat suffered heavy damage during the Cerro Grande Fire. Specifically, two primary areas considered as critical habitat for the Mexican spotted owl located on Forest Service land near LANL suffered almost 100 percent vegetation mortality. The fire may also have long-term effects on the habitat of several state-listed species, including the Jemez Mountains salamander. As noted in Section 4.2.7.2, two projects undertaken after the fire to enlarge culverts in the lower Pajarito

Canyon disturbed about 0.6 hectares (1.5 acres) of wetland vegetation composed primarily of willow trees. This wetland habitat was part of the habitat area used by the southwestern willow flycatcher at LANL, however, it was not a confirmed nesting habitat and was of marginal quality (DOE 2000h).

Table 4–7 Listed Threatened and Endangered Species, Species of Concern, and Other Unique Species That Occur or May Occur at LANL

Species	*Federal Classification*	*State Classification*	*Occurrence on LANL*
Mammals			
Big free-tailed bat	Special Concern	Special Concern	Migratory visitor
Fringed myotis	Special Concern	Special Concern	Observed on LANL, BNM, and SFNF lands
Goat peak pika	Special Concern	Special Concern	Observed on LAC and BNM lands
Long-eared myotis	Special Concern	Special Concern	Summer resident
Long-legged myotis	Special Concern	Special Concern	Summer resident
New Mexico jumping mouse	Special Concern	Threatened	Permanent resident on LAC and SFNF lands
Occult little brown bat	Special Concern	Special Concern	Observed on SFNF lands
Pale Townsend's big-eared bat	Special Concern	Special Concern	Observed on LANL and BNM lands
Small-footed myotis	Special Concern	Special Concern	Observed on LANL, BNM, and SFNF lands
Spotted bat	Special Concern	Threatened	Permanent resident on BNM and SFNF lands; Seasonal resident on LANL
Yuma myotis	Special Concern	Special Concern	Summer resident
Birds			
American peregrine falcon	Special Concern	Threatened	Forages on LANL
Baird's sparrow	Special Concern	Threatened	Observed on SFNF lands
Bald eagle	Threatened	Threatened	Winter visitor
Ferruginous hawk	Special Concern	Protected	Observed as a breeding resident
Gray vireo	Special Concern	Threatened	Observed on LAC, BNM, and SFNF lands
Loggerhead shrike	Special Concern	Special Concern	Observed on LAC, BNM, and SFNF lands
Mexican spotted owl	Threatened	Special Concern	Breeding resident on LANL, LAC, BNM, and SFNF lands; Critical habitat designated on SFNF lands
Northern goshawk	Special Concern	Special Concern	Observed as a breeding resident
Southwestern willow flycatcher	Endangered	Endangered	Potential presence on LANL and White Rock Canyon; Potential nesting area on LANL; Present in Jemez Mountains; Present in riparian zone near Española
White-faced ibis	Special Concern	Unlisted	Summer resident
Whooping crane	Endangered	Endangered	Migratory visitor along the Rio Grande and Cochiti Lake
Amphibians			
Jemez Mountain salamander	Special Concern	Threatened	Permanent resident
Fish			
Flathead chub	Special Concern	Unlisted	Permanent resident of the Rio Grande between Española and the Cochiti Reservoir
Plants			
Checkered lily	Unlisted	Special Concern	Observed on LAC, BNM, and SFNF lands
Helleborine orchid	Unlisted	Special Concern	Rare
Wood lily	Unlisted	Endangered	Observed on LAC, BNM, and SFNF lands
Yellow lady's slipper orchid	Unlisted	Endangered	Observed on BNM lands

LAC = Los Alamos County; BNM = Bandelier National Monument; SFNF = Sante Fe National Forest
Source: DOE 1999b.

4.2.8 Cultural and Paleontological Resources

4.2.8.1 Prehistoric Resources

Prehistoric resources at LANL refer to any material remains and items used or modified by people before the establishment of a European presence in the upper Rio Grande Valley in the early seventeenth century. Archaeological surveys have been conducted of approximately 75 percent of the land within LANL (with 60 percent of the area surveyed receiving 100 percent coverage) to identify the cultural resources present. The majority of these surveys emphasized prehistoric Native American cultural resources, including pueblos, rock shelters, rock art, water control features, trails, and game traps. A total of 1,295 prehistoric sites has been recorded on LANL, of which 1,192 have been assessed for potential nomination to the National Register of Historic Places. Of these, 770 sites were determined to be eligible, 322 sites potentially eligible, and 100 sites ineligible. The remaining 103 sites, which have not been assessed for nomination to the National Register of Historic Places, are assumed to be potentially eligible until assessed. Two areas in the vicinity of LANL have been established as National Register of Historic Places sites or districts: Bandelier National Monument (named as a monument in 1916) and Puye Cliffs Historical Ruins (DOE 1996g).

Cerro Grande Fire affected 304 prehistoric sites; however, impacts to these sites are not fully known. Potential impacts could result from burned out tree root systems forming conduits for modern debris and water to mix with subsurface archaeological deposits and may provide an entry point for burrowing animals. Also, snags or dead or dying trees may fall and uproot artifacts (DOE 2000h). Areas at LANL burned by the Cerro Grande Fire will be surveyed for impacts over the next several field seasons.

TA-18 contains two prehistoric cultural resources. One site is comprised of approximately 40 prehistoric cavates (i.e., man-made rooms excavated in the tuff cliff faces of canyon walls). This complex of cavates was occupied discontinuously starting in the Coalition period and as late as the Post-Pueblo Revolt period. The second site is a rock shelter of undetermined Pueblo period age. Both sites have been determined eligible for the National Register of Historic Places by the New Mexico State Historic Preservation Office.

TA-55 contains one prehistoric lithic scatter that the New Mexico State Historic Preservation Office has determined is not eligible for the National Register of Historic Places.

4.2.8.2 Historic Resources

Historic resources present within LANL boundaries and on the Pajarito Plateau can be attributed to three phases: Spanish colonial, early U.S. territorial/statehood, and the nuclear energy period. Because of the very well-defined changes in the function of LANL, the nuclear energy period is further broken into three periods: World War II/early nuclear weapon development, early cold war, and late cold war. The numbers of artifacts or sites identified from each period are as follows: 0 from the Spanish colonial period, 87 from the early U.S. territorial/statehood period, 515 from World War II/early nuclear weapon development and early cold war periods, and 1,717 from the late cold war period; Thus, a total of 2,319 historic artifacts or sites has been identified at LANL. Of these, 214 have been recorded through site surveys. The remaining 2,105 resources were identified by reviewing the construction dates presented in a number of LANL documents and the site cultural resources database.

The Cerro Grande Fire affected 58 historic sites; some resources were severely impacted. Many wooden structures from the homestead era and from the Manhattan Project/cold war period and various Manhattan Project artifacts were adversely affected. The fire destroyed virtually all wooden buildings associated with the homestead era and sites were largely reduced to rubble. The V-site, which was among the last vestiges of the Manhattan Project at Los Alamos and the site where work was conducted on the Trinity device, was partially destroyed. Building TA-16-516, the Trinity Assembly Building, survived the fire. The leveling of a staging area in TA-49 during the fire destroyed one and damaged two other cultural resource sites. Also, two historic structures at TA-2 were adversely impacted by postfire activities (DOE 2000h).

At TA-18 early U.S. Territorial/Statehood period sites include a mule train trail of undetermined National Register of Historic Places eligibility that was used to haul hay from the Valles Caldera to the Ashley Pond cabin. The Ashley Pond cabin is listed on the New Mexico State Register of Historic Places. TA-18 contains 50 buildings and structures dating to WWII through the Early Cold War periods. A historic building eligibility assessment of these buildings is currently underway. Extensive erosion and storm-water control efforts initiated after the Cerro Grande Fire will have beneficial effects on the historic Ashley Pond cabin. This structure has been surrounded by concrete barriers and sandbags to prevent damage from debris carried by storm-water runoff. Construction of a flood retention structure upstream will also provide the Ashley Pond cabin additional protection from flooding (DOE 2000h).

Historic resources at TA-55 include the early U.S. Territorial/Statehood period homestead site that is not eligible for the National Register of Historic Places. Also present is a National Register of Historic Places-eligible early U.S. Territorial/Statehood period structure.

4.2.8.3 Native American Resources

Consultations to identify traditional cultural properties were conducted with 19 Native American tribes in connection with the preparation of the *LANL SWEIS*. Two Hispanic communities were also contacted. These consultations identified 15 ceremonial and archaeological sites, 14 natural features, 10 ethnobotanical sites, 7 artisan material sites, and 8 subsistence features. In addition to physical cultural entities, concern has been expressed that "spiritual," "unseen," "undocumentable," or "beingness" aspects can be present at LANL that are an important part of Native American culture and may be adversely impacted by LANL's presence and operation. Additional consultations regarding traditional cultural properties are ongoing for LANL and other nearby DOE administered properties.

4.2.8.4 Paleontological Resources

No paleontological sites are reported to occur within LANL boundaries, and the near-surface stratigraphy is not conducive to preserving plant and animal remains. These near-surface materials are volcanic ash and pumice that were extremely hot when deposited.

4.2.9 Socioeconomics

Statistics for population, housing, community services, and local transportation are presented for the region of influence, a three-county area in New Mexico **(Figure 4–8)** in which 89.7 percent of all LANL employees reside (see **Table 4–8**).

4.2.9.1 Regional Economic Characteristics

Between 1990 and 1999, the civilian labor force in the Tri-County area increased 14.4 percent to the 1999 level of 92,189. In 1999, the annual unemployment average in the region of influence was 3.7 percent, which was less than the annual unemployment average of 5.6 percent for New Mexico (DOL 2000).

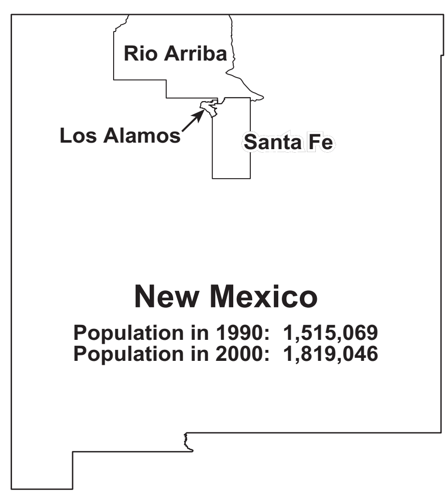


Figure 4–8 Counties in the LANL Region of Influence

In 1997, government agencies and enterprises represented the largest sector of employment in the Tri-County area (35.6 percent). This was followed by service activities (29.5 percent) and retail (20.7 percent). The totals for these employment sectors in New Mexico were 25.1 percent, 27.5 percent, and 23.7 percent, respectively (NMDL 1998).

Table 4–8 Distribution of Employees by Place of Residence in the LANL Region of Influence in 1996

County	*Number of Employees* [a]	*Total Site Employment (percent)*
Los Alamos	5,381	50.8
Rio Arriba	2,149	20.3
Sante Fe	1,967	18.6
Region of influence total	9,497	89.7

[a] Data not available for nontechnical contractors or consultants.
Source: DOE 1999b.

4.2.9.2 Demographic Characteristics

The 2000 demographic profile of the region of influence population and income information is included in **Table 4–9**. Persons self-designated as minority individuals comprise 57.9 percent of the total population. This minority population is composed largely of Hispanic or Latino and American Indian residents. The Pueblos of San Ildefonso, Santa Clara, San Juan, Nambe, Pojoaque, Tesques, and part of the Jicarilla Apache Indian Reservation are included in the region of influence.

Income information for the LANL region of influence is included in **Table 4–10**. There are significant differences in the income levels among the three counties, especially between Rio Arriba County, at the low end, and Los Alamos County, at the upper end. The median household income in Los Alamos County is over double that of the New Mexico state average while the median household income of Rio Arriba County is below the state average. In 1997, only 2.7 percent of the population in Los Alamos was below the official poverty level while in Rio Arriba County, 22.5 percent of the population was below the poverty level.

Table 4–9 Demographic Profile of the Population in the LANL Region of Influence

	Los Alamos	*Rio Arriba*	*Sante Fe*	*Region of Influence*
Population				
2000 population	18,343	41,190	129,292	188,825
1990 population	18,115	34,365	98,928	151,408
Percent change from 1990 to 2000	1.3	19.9	30.7	24.7
Race (2000) (percent of total population)				
White	90.3	56.6	73.5	71.5
Black or African American	0.4	0.3	0.6	0.5
American Indian and Alaska Native	0.6	13.9	3.1	5.2
Asian	3.8	0.1	0.9	1.0
Native Hawaiian & Other Pacific Islander	0.0	0.1	0.1	0.1
Some other race	2.7	25.6	17.7	18.0
Two or more races	2.3	3.3	4.1	3.7
Percent minority	17.9	86.4	54.5	57.9
Ethnicity (2000)				
Hispanic or Latino	2,155	30,025	63,405	95,585
Percent of total population	11.7	72.9	49.0	50.6

Source: DOC 2001.

Table 4–10 Income Information for the LANL Region of Influence

	Los Alamos	*Rio Arriba*	*Sante Fe*	*New Mexico*
Median household income 1997 ($)	74,253	25,036	37,882	30,836
Percent of persons below poverty line (1997)	2.7	22.5	11.9	19.3

Source: DOC 2000.

4.2.9.3 Housing and Community Services

Table 4–11 lists the total number of occupied housing units and vacancy rates in the region of influence. In 1990, the Tri-County area contained 63,386 housing units, of which 56,514 were occupied. The median value of owner-occupied units was $125,100 in Los Alamos County, which is higher than the other two counties and over twice the median value of units in Rio Arriba County. The vacancy rate was lowest in Los Alamos County (4.7 percent) and highest in Rio Arriba County (20.2 percent). During the Cerro Grande Fire, approximately 230 housing units were destroyed or damaged in northern portions of Los Alamos County (DOE 2000h). As a result, vacancy rates have decreased.

Community services include public education and healthcare (i.e., hospitals, hospital beds, and doctors). In 1998, student enrollment totaled 26,290 in the region of influence and the average student-to-teacher ratio was 17:1 (Department of Education 2000). In 1998, three hospitals served the Tri-County area with a hospital bed-to-population ratio of 1.9 hospital beds per 1,000 persons. The average region of influence's physician-to-population ratio was 2.7 physicians per 1,000 persons (Gaquin and DeBrandt 2000).

Table 4–11 Housing and Community Services in the LANL Region of Influence

	Los Alamos	*Rio Arriba*	*Sante Fe*	*Region of Influence*
Housing (1990) [a]				
Total units	7,565	14,357	41,464	63,386
Occupied housing units	7,213	11,461	37,840	56,514
Vacant units	352	2,896	3,624	6,872
Vacancy rate (percent)	4.7	20.2	8.7	10.8
Median value ($)	125,100	57,900	103,300	Not available
Public Education (1998) [b]				
Total enrollment	3,674	6,917	15,699	26,290
Student-to-teacher ratio	14.8:1	18:1	17.2:1	17:1
Community Healthcare (1998) [c]				
Hospitals	1	1	1	3
Hospital beds per 1,000 persons	2.9	2.1	1.7	1.9
Physicians per 1,000 persons	2.6	0.9	3.3	2.7

[a] DOE 1999b.
[b] Department of Education 2000.
[c] Gaquin and DeBrandt 2000.

4.2.9.4 Local Transportation

Motor vehicles are the primary means of transportation to LANL. Regional transportation route(s) connecting LANL to Albuquerque and Santa Fe are I–25 to U.S. 84/285 to NM 502; to Española are NM 30 to NM 502; and to Jemez Springs and western communities is NM 4. Hazardous and radioactive material shipments leave or enter LANL from East Jemez Road to NM 4 to NM 502 (see Figure 4–1). Only two major roads, NM 502 and NM 4, access Los Alamos County. Los Alamos County traffic volume on these two segments of highway is primarily associated with LANL activities.

A public bus service located in Los Alamos operates within Los Alamos County. The Los Alamos bus system consists of seven buses that operate five days a week. The nearest commercial bus terminal is located in Santa Fe. The nearest commercial rail connection is at Lamy, New Mexico, 83 kilometers (52 miles) southeast of LANL. LANL does not currently use rail for commercial shipments. The primary commercial international airport in New Mexico is located in Albuquerque. The small Los Alamos County Airport is owned by the Federal Government, and the operations and maintenance are performed by the County of Los Alamos. The airport is located parallel to East Road at the southern edge of the Los Alamos community. Until January 1996, the airport provided regular passenger and cargo service through specialized contract carriers such as Ross Aviation, which were under contract with DOE to provide passenger and cargo air service to Los Alamos County and LANL. DOE continues to negotiate with various companies to provide for service to the Los Alamos Airport.

4.2.10 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. As discussed in Appendix E, minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multiracial. Persons whose income is below the Federal poverty threshold are designated as low-income.

There are three candidate locations at LANL for location of missions currently performed at TA-18. These are TA-18,TA-39, and TA-55. **Figure 4–9** shows candidate locations at LANL and regions of potential radiological impact. As shown in the figure, areas potentially at radiological risk from the current missions performed at TA-18 include the City of Santa Fe and Indian Reservations in North Central New Mexico. Eight counties are included or partially included in the potentially affected area (See **Figure 4–10**): Bernallilo, Los Alamos, Mora, Rio Arriba, Sandoval, San Miguel, Santa Fe, and Taos. **Table 4–12** provides the racial and Hispanic composition for these counties using data obtained from the decennial census conducted in 2000. In the year 2000, a majority of these county residents designated themselves as members of a minority. Hispanics and American Indians/Alaska Natives comprised over 90 percent of the minority population. As a percentage of the total resident population in 2000, New Mexico had the largest percentage minority population (55 percent) among the contiguous states and the second largest percentage minority population among all of the states (only Hawaii had a larger percentage minority population (77 percent)).

Figure 4–11 compares the growth in the minority populations in the potentially affected counties between 1990 and 2000. As discussed in Section E.5.1 of Appendix E, data concerning race and Hispanic origin from the 2000 Census cannot be directly compared with that for the 1990 Census because the racial categories used in the two enumerations were different. Bearing this change in mind, the minority population in potentially affected counties increased from approximately 49 percent to 54 percent in the decade from 1990 to 2000. Hispanics and American Indians/Alaska Natives accounted for over 80 percent of the increase in minority population during the decade. For comparison, minorities composed approximately one-quarter of the total population of the United States in 1990 and nearly one-third of the total population in 2000.

The percentage of low-income population at risk in potentially affected counties in 1990 was approximately 13 percent. In 1990, nearly 13 percent of the total population of the continental United States reported incomes less than the poverty threshold. In terms of percentages, minority populations at risk are relatively large in comparison with the national percentage, while the percentage low-income population at risk is commensurate with the corresponding national percentage. Complete census data with block group resolution for minority and low-income populations obtained from the decennial census of 2000 are scheduled for publication in 2002.

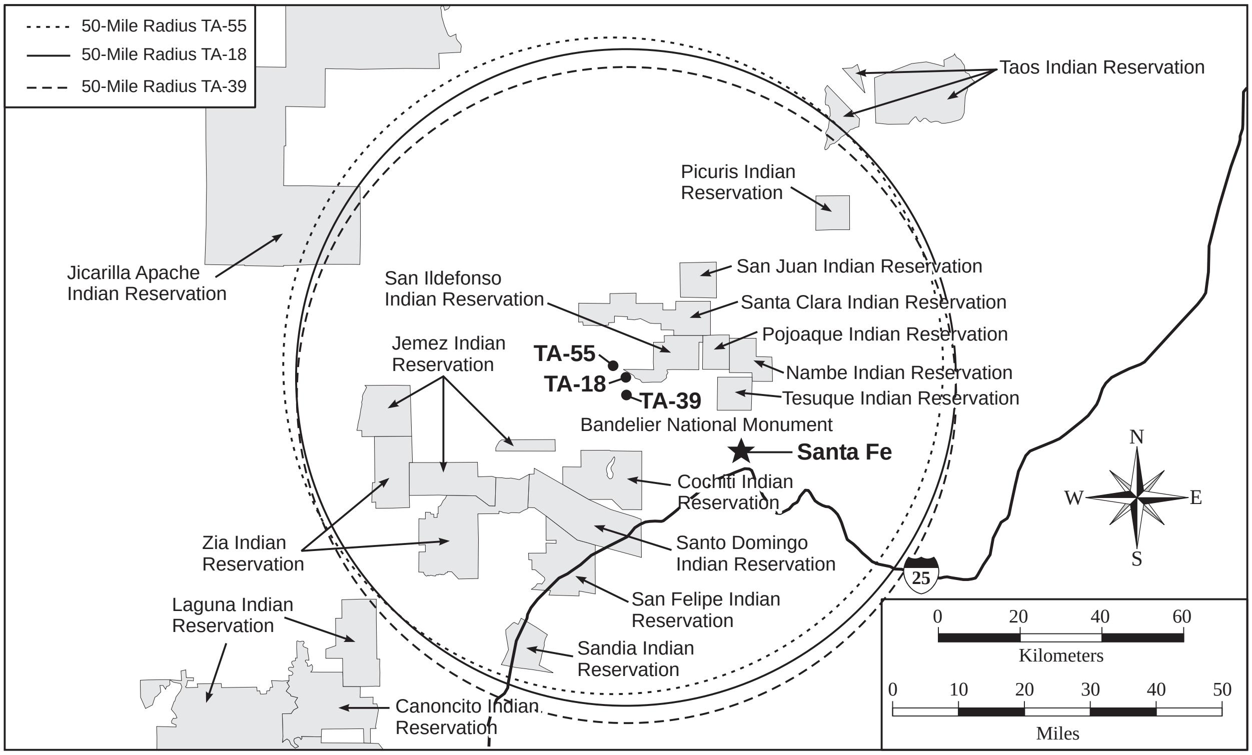


Figure 4–9 Candidate Locations and Indian Reservations Surrounding LANL

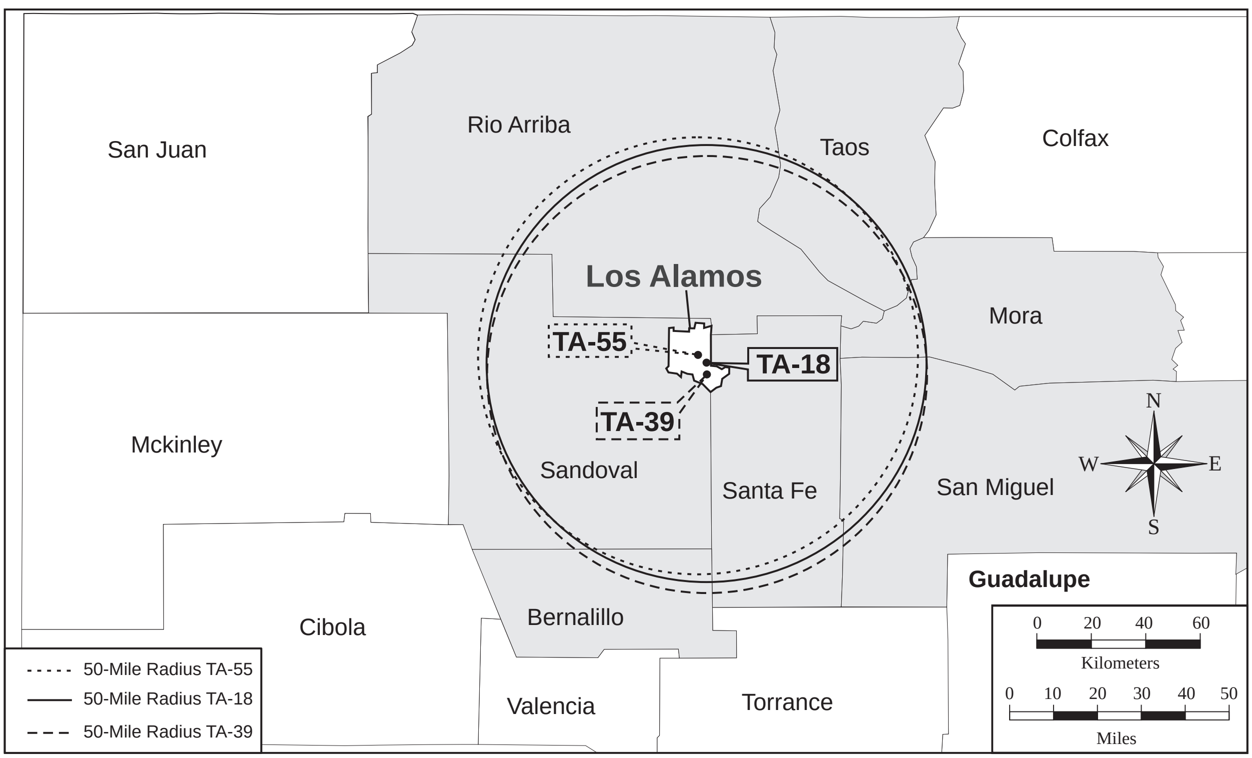


Figure 4–10 Potentially Affected Counties Surrounding LANL

Table 4–12 Populations in Potentially Affected Counties Surrounding LANL in 2000

Population Group	*Population*	*Percentage of Total*
Minority	488,850	54.3
Hispanic	400,673	44.5
Black/African American	16,204	1.8
American Indian/Alaska Native	44,430	4.9
Asian	13,195	1.5
Native Hawaiian/Pacific Islander	607	0.1
Two or More Races	13,741	1.5
Some Other Race	1,498	0.2
White	410,348	45.6
Total	900,696	100.0

Source: DOC 2001.

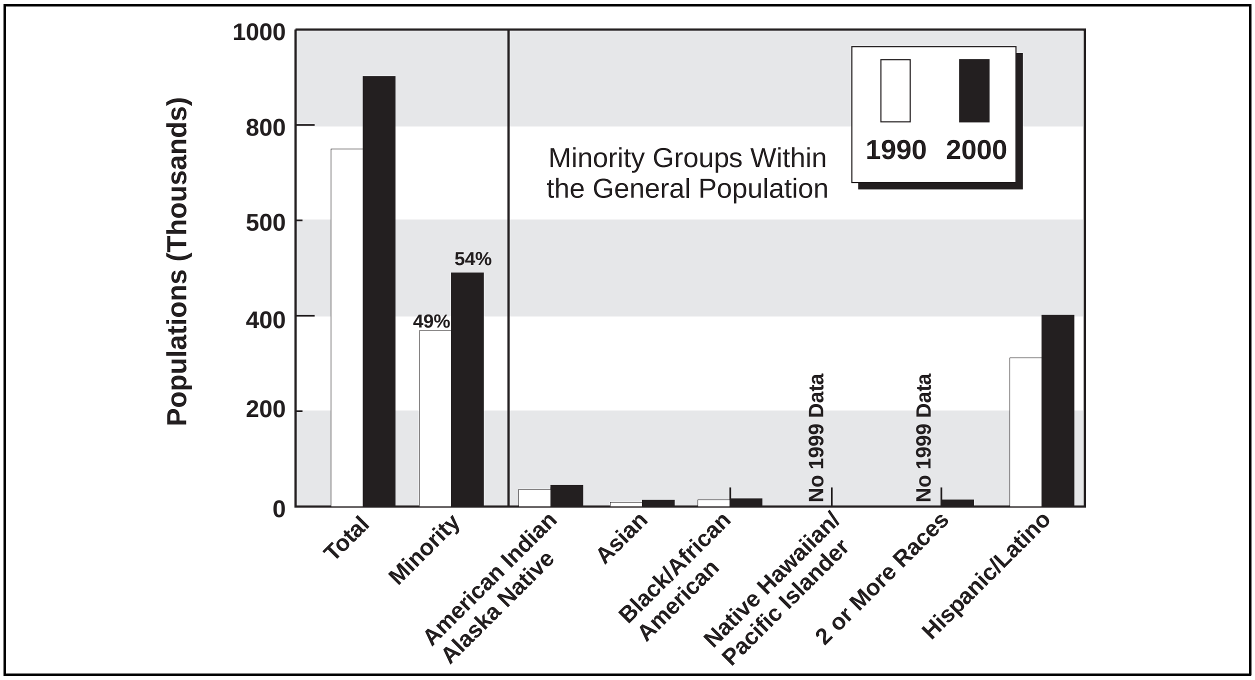


Figure 4–11 Comparison of Populations in Potentially Affected Counties Surrounding LANL in 1990 and 2000

4.2.11 Existing Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health that result from acute and chronic exposure to ionizing radiation and hazardous chemicals.

4.2.11.1 Radiation Exposure and Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of LANL are shown in **Table 4–13**. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to LANL operations.

Table 4–13 Sources of Radiation Exposure to Individuals in the LANL Vicinity Unrelated to LANL Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural Background Radiation	
Total external (cosmic and terrestrial) [a]	120
Internal terrestrial and global cosmogenic [b]	40
Radon in homes (inhaled)	200 [b, c]
Other Background Radiation [b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	less than 1
Air travel	1
Consumer and industrial products	10
Total	425

[a] LANL 2000f.
[b] NCRP 1987.
[c] An average for the United States.

Releases of radionuclides to the environment from LANL operations provide another source of radiation exposure to individuals in the vicinity of LANL. Types and quantities of radionuclides released from LANL operations in 1999 are listed in *Environmental Surveillance at Los Alamos During 1999* (LANL 2000f). The releases are summarized in Sections 4.2.3.2 and 4.2.6.1 of this EIS. The doses to the public resulting from these releases are presented in **Table 4–14**. These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment,* and are much lower than those from background radiation.

Table 4–14 Radiation Doses to the Public from Normal LANL Operations in 1999 (total effective dose equivalent)

	Atmospheric Releases		*Liquid Releases*		*Total*	
Members of the Public	*Standard [a]*	*Actual*	*Standard [a]*	*Actual*	*Standard [a]*	*Actual*
Maximally exposed offsite individual (millirem)	10	0.40	4	0.25	100	0.65
Population within 80 kilometers (50 miles) (person-rem) [b]	None	0.30	None	~0	100	0.30
Average individual within 80 kilometers (50 miles) (millirem) [c]	None	0.0011	None	~0	None	0.0011

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10-millirem-per-year limit from airborne emissions is required by the Clean Air Act (40 CFR 61) and the 4-millirem-per-year limit is required by the Safe Drinking Water Act (40 CFR 141). For this EIS, the 4-millirem-per-year value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 millirem per year is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, *Radiation Protection of the Public and the Environment: Proposed Rule,* as published in 58 FR 16268. If the potential total dose exceeds the 100-person-rem value, the contractor operating the facility would be required to notify DOE.
[b] About 264,000 based on county population estimates for 1999.
[c] Obtained by dividing the population dose by the number of people living within 80 kilometers (50 miles) of the site.
Note: About 80 percent of the dose to the maximally exposed onsite individual was attributable to TA-18 operations. The fractional dose contribution to offsite receptors from TA-18 operations is very small.
Source: LANL 2000f.

Using a risk estimator of one latent cancer death per 2,000 person-rem to the public (see Appendix B), the fatal cancer risk to the maximally exposed offsite member of the public due to radiological releases from LANL operations is estimated to be 3.3×10^{-7}. The estimated probability of this maximally exposed person dying of cancer at some point in the future from radiation exposure associated with one year of LANL operations is less than one in one million (it takes several to many years from the time of radiation exposure for a cancer to manifest itself).

According to the same risk estimator, 1.5×10^{-4} excess fatal cancers are projected in the population living within 80 kilometers (50 miles) of LANL from normal LANL operations. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 1999 from all causes in the population of 264,000 living within 80 kilometers (50 miles) of LANL was 528. This expected number of fatal cancers is much higher than the 1.5×10^{-4} fatal cancers estimated from LANL operations in 1999.

Members of the public passing by the TA-18 facility along Pajarito Road could receive an external radiation dose from critical assembly operations at TA-18. Based on radiation doses that have been measured along Pajarito Road, the road is closed to the public for any operation that would result in more than 4.75 millirem in any hour along the road. As a result, the maximum dose that a member of the public would receive from a single operation at TA-18 would be 4.75 millirem (LANL 2001a).

LANL workers receive the same dose as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at LANL from operations in 1998 are presented in **Table 4–15**. These doses fall within the radiological regulatory limits of 10 CFR 835. According to a risk estimator of one latent fatal cancer per 2,500 person-rem among workers (see Appendix B), the number of projected fatal cancers among LANL workers from normal operations in 1998 is 0.065. The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

Table 4–15 Radiation Doses to Workers from Normal LANL Operations in 1998 (total effective dose equivalent)

Occupational Personnel	*Onsite Releases and Direct Radiation*	
	Standard [a]	*Actual*
Average radiation worker (millirem)	None [b]	85
Total workers [c] (person-rem)	None	162

[a] The radiological limit for an individual worker is 5,000 millirem per year (10 CFR 835). However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 millirem per year (DOE 1999e); the site must make reasonable attempts to maintain individual worker doses below this level.

[b] No standard is specified for an average radiation worker; however, the maximum dose that this worker may receive is limited to that given in footnote [a].

[c] There were 1,916 workers with measurable doses in 1998.

Source: DOE 1998c.

External radiation doses have been measured in areas of TA-18 and TA-55 that may contain radiological sources for comparison with offsite natural background radiation levels. Measurements taken in 1999 showed average doses within TA-18 and TA-55 of 189 millirem and 157 millirem, respectively, compared to an average offsite dose of 126 millirem (LANL 2000f).

In 1999, the average concentration in air of plutonium-239, gross alpha, and gross beta radiation on the LANL site were measured to be 1.5×10^{-18} curies per cubic meter, 9.4×10^{-16} curies per cubic meter, and 1.3×10^{-14} curies per cubic meter, respectively. The value of plutonium-239 does not include a relatively high "hot spot" in Technical Area 54. The concentration of plutonium-239 was about twice that measured at offsite regional locations; the concentrations of gross alpha and beta radiation were about the same as measured regionally (LANL 2000f). No specific measurements were reported for Technical Areas 18 or 55, but the concentrations would be expected to be similar to the average site values.

4.2.11.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at LANL via inhalation of air containing hazardous chemicals released to the atmosphere by LANL operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Baseline air emission concentrations for air pollutants and their applicable standards are presented in Section 4.2.3.1. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are compared with applicable guidelines and regulations.

Chemical exposure pathways to LANL workers during normal operations may include inhaling the workplace atmosphere, drinking LANL potable water, and possible other contact with hazardous materials associated with work assignments. Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. LANL workers are also protected by adherence to the Occupational Safety and Health Administration (OSHA) and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals used in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at LANL are substantially better than required by standards.

4.2.11.3 Health Effects Studies

Numerous epidemiological studies have been conducted in the LANL area. These studies have been summarized in the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management (SSM PEIS)* (DOE 1996f). One study conducted by the New Mexico Department of Health reported elevations in brain cancer incidence during the mid to late 1980s, compared to state and national reference populations, but random fluctuation could not be ruled out. Breast cancer incidence rates in Los Alamos from 1970 to 1990 remained level, but higher than New Mexico rates. Reproductive and demographic factors known to increase the risk of breast cancer have been prevalent in the county. Ovarian cancer incidence in the county from 1986 to 1990 was approximately twofold greater than that observed in a New Mexico State reference population. In the mid to late-1980s, a twofold excess risk of melanoma was observed in Los Alamos County compared with a New Mexico State reference population. A more recent study observed a fourfold increase in thyroid cancer incidence during the late 1980s and early 1990s compared with the state as a whole, but the rate began to decline in 1994 and 1995. No statistically significant excess cancers were reported for male workers exposed to plutonium. However, statistically significant excesses in kidney cancer and lymphomatic leukemia were observed in male workers exposed to external radiation. For more detailed descriptions of studies reviewed and the findings, refer to Appendix Section D.1.2 of the *LANL SWEIS* and to Appendix Section E.4.6 of the *SSM PEIS* (DOE 1996f).

4.2.11.4 Accident History

Although LANL experienced a number of criticality accidents in the period of 1945 to the early 1980s, a review of more recent LANL annual environmental and accident reports indicates that there have been no accidents since that time that have resulted in significant adverse impacts to workers, the public, or the environment (DOE 1996g). During the review period, from 1986 to 1990, site operations were much higher than in previous years and also higher than what is anticipated for the future (DOE 1996g).

On May 4, 2000, the National Park Service at Bandelier National Monument set a prescribed fire that subsequently burned out of control. This Cerro Grande Fire damaged or destroyed 112 LANL structures and about 230 residential structures in the Los Alamos town site. By the time it was contained, it had burned 3,061 hectares (7,650 acres) within the boundaries of LANL. LANL is conducting an extensive environmental monitoring and sampling program to evaluate the effects of that fire at the laboratory and especially to evaluate if public and worker health and the environment were adversely impacted by the fire on laboratory land. The program will identify changes from prefire baseline conditions that will aid in evaluating potential future impacts, especially those from any contaminants that may have been transported off site (LANL 2000f).

4.2.11.5 Emergency Preparedness

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program includes emergency planning, training, preparedness, and response. The emergency management program was activated on May 5, 2000 to coordinate emergency management operations during the Cerro Grande Fire.

DOE maintains equipment and procedures to respond to situations where human health or the environment is threatened. These include specialized training and equipment for the local fire department, local hospitals, state public safety organizations, and other government entities that may participate in response actions, as well as specialized assistance teams (DOE Order 151.1, *Comprehensive Emergency Management System*). These programs also provide for notification of local governments whose constituencies may be threatened. Broad ranges of exercises are run to ensure the systems are working properly, from facility-specific exercises to regional responses. In addition, DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency responses to an accidental explosion at Hanford in May 1997.

4.2.12 Waste Management

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies, and in compliance with all applicable Federal and state statutes and DOE orders.

4.2.12.1 Waste Inventories and Activities

LANL manages the following types of waste: transuranic, mixed transuranic, low-level radioactive, mixed low-level radioactive, hazardous, and nonhazardous. Because there is no transuranic or mixed transuranic waste associated with TA-18 operations, these waste types are not discussed in this EIS. Waste generation rates and the inventory of stored waste from activities at LANL are provided in **Table 4–16**. Selected waste management facilities at LANL are summarized in **Table 4–17**.

Table 4–16 Selected Waste Generation Rates and Inventories at LANL

Waste Type	*Generation Rate (cubic meters per year)*	*Inventory (cubic meters)*
Low-level radioactive	2,840 [a]	Not available
Mixed low-level radioactive	98 [a]	759 [a]
Hazardous (in kilograms)	860,600 [a,b]	Not applicable [c]
Nonhazardous		
Liquid	692,857 [d]	Not applicable [c]
Solid	5,453 [d]	Not applicable [c]

[a] DOE 1999b.
[b] This waste type also includes biomedical waste.
[c] Generally, hazardous and nonhazardous waste are not held in long-term storage.
[d] DOE 1999i.
Note: The generation rates are attributed to facility operations and do not include the waste generated from environmental restoration actions.

Table 4–17 Selected Waste Management Facilities at LANL

Facility Name/Description	*Capacity*	*Status*	*Applicable Waste Type*			
			Low-Level Radioactive Waste	*Mixed Low-Level Radioactive Waste*	*Hazardous*	*Nonhazardous*
Treatment Facility (cubic meters per year)						
Low-level radioactive waste compaction	76	Online	X			
Sanitary wastewater treatment	1,060,063	Online				X
Storage Facility (cubic meters)						
Low-level radioactive waste storage	663	Online	X			
Mixed low-level radioactive waste storage	583	Online		X		
Hazardous waste storage	1,864	Online			X	
Disposal Facility						
TA-54 Area G low-level radioactive waste disposal (cubic meters)	252,500[a]	Online	X			
Sanitary tile fields (cubic meters per year)	567,750	Online				X

[a] Current inventory of 250,000 cubic meters. Capacity will be expanded as part of implementation of the *LANL SWEIS* Record of Decision.
Source: DOE 1999i.

Although not listed on the National Priorities List, LANL adheres to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidelines for environmental restoration projects that involve certain hazardous substances not covered by the Resource Conservation and Recovery Act (RCRA). LANL's environmental restoration program originally consisted of approximately 2,100 potential release sites (DOE 1999i). At the end of 1999, there remained 1,206 potential release sites requiring investigation or remediation and 118 buildings awaiting decontamination and decommissioning. Potential release sites at TA-18 have been investigated and characterized. Most of the potential release sites have been recommended for no further action, following site characterization. Several potential release sites at TA-18 have undergone either interim or final remediation to remove contaminants and decrease the potential for future releases and migration off site. Based on a review by LANL's Environmental Restoration Project, the boundary of Potential Release Site 48-001 overlaps a small area in the corner of the proposed relocation site at TA-55. This area of overlap involves possible surface soil contamination from TA-48 stack emissions. Further investigation and any necessary remediation of this site will be completed under LANL's environmental restoration program (LANL 2001b) and in accordance with LANL's Hazardous Waste Facility Permit. More information on regulatory requirements for waste disposal is provided in Chapter 6.

4.2.12.2 Low-Level Radioactive Waste

Solid low-level radioactive waste generated by LANL's operating divisions is characterized and packaged for disposal at the onsite low-level radioactive waste disposal facility at TA-54, Area G. Low-level radioactive waste minimization strategies are intended to reduce the environmental impact associated with low-level radioactive waste operations and waste disposal by reducing the amount of low-level radioactive waste generated and/or minimizing the volume of low-level radioactive waste that will require storage or disposal onsite (LANL 2000a).

A 1998 analysis of the low-level radioactive waste landfill at TA-54, Area G, indicated that at previously planned rates of disposal, the disposal capacity would be exhausted in a few years. Reduction in low-level radioactive waste generation has extended this time to approximately five years; however, potentially large volumes of waste from planned construction upgrades could rapidly fill the remaining capacity (LANL 2000a).

As part of the implementation of the Record of Decision in the *LANL SWEIS*, DOE will continue onsite disposal of LANL-generated low-level radioactive waste using the existing footprint at the Area G low-level waste disposal area and will expand disposal capacity into Zones 4 and 6 at Area G. This expansion would cover up to 29 hectares (72 acres). Additional sites for low-level radioactive waste disposal at Area G would provide onsite disposal for an additional 50 to 100 years (64 FR 50797, LANL 2000a).

Liquid low-level radioactive waste is transferred through a system of pipes and by tanker trucks to the Radioactive Liquid Waste Treatment Facility at TA-50, Building 1. The radioactive components are removed and disposed of as solid low-level radioactive waste at TA-54, Area G. The remaining liquid is discharged to a permitted outfall (LANL 2000a).

4.2.12.3 Mixed Low-Level Radioactive Waste

There are seven major mixed low-level radioactive waste streams at LANL: circuit boards, gloveboxes, lead parts, research and development chemicals, personal protective equipment, fluorescent tubes, and waste generated from spills and spill cleanup. Typically, mixed low-level radioactive waste is transferred to a satellite storage area once generated. Whenever possible, mixed low-level materials are surveyed to confirm the radiological contamination levels, and if decontamination will eliminate either the radiological or the hazardous component, materials are decontaminated and removed from the mixed low-level radioactive waste category (LANL 2000a).

Proper waste management and Department of Transportation documentation are provided for solid waste operations at TA-54, Area G or Area L, to process remaining mixed low-level radioactive waste for storage, bulking, and transportation. From TA-54, mixed low-level radioactive waste is sent to commercial and DOE treatment and disposal facilities. The waste is treated/disposed of by various processes (e.g., segregation of hazardous components, macroencapsulation, or incineration) (LANL 2000a).

In October 1995, the State of New Mexico issued a Federal Facility Compliance Order to both DOE and LANL requiring compliance with the site treatment plan. That plan documents the development of treatment capacities and technologies or use of offsite facilities for treating mixed waste generated at LANL that is stored beyond the one-year time frame (LANL 2000f).

4.2.12.4 Hazardous Waste

Most LANL activities generate some amount of hazardous waste. Hazardous waste commonly generated at LANL includes many types of laboratory research chemicals, solvents, acids, bases, carcinogens, compressed gases, metals, and other solid waste contaminated with hazardous waste. This may include equipment, containers, structures, and other items intended for disposal and contaminated with hazardous waste (e.g., compressed gas cylinders). After the hazardous waste is collected, it is sorted and segregated. Some materials are reused within LANL, and others are decontaminated for reuse. Those materials that cannot be decontaminated or recycled are packaged and shipped to offsite RCRA-permitted treatment and disposal facilities (LANL 2000a).

4.2.12.5 Nonhazardous Waste

Both LANL and Los Alamos County use the same landfill located within LANL boundaries. The landfill is operated under a special permit by Los Alamos County. The Los Alamos County Landfill received about 20 million kilograms (22,013 tons) of solid waste from all sources during the period of July 1995 through June 1996, with LANL contributing about 22 percent of the solid waste. Since the Cerro Grande Fire, the generation of wastes from community and LANL cleanup activities have increased several fold. The Los Alamos County landfill is scheduled for closure on June 30, 2004. A replacement facility, which would be located offsite, would then be used by LANL for nonhazardous waste disposal. It is currently anticipated that the replacement facility would be located within 160 kilometers (100 miles) of LANL. Both LANL and Los Alamos County would need to transport their wastes to the new facility.

Sanitary liquid waste is delivered by dedicated pipelines to the Sanitary Wastewater Systems Consolidation Plant at TA-46. The plant has a design capacity of 2.27 million liters (600,000 gallons) per day, and in 2000 processed a maximum of about 950,000 liters (250,000 gallons) per day. Some septic tank pumpings are delivered periodically to the plant for treatment via tanker truck. Sanitary waste is treated by an aerobic digestion process. After treatment, the liquid from this process is recycled to the TA-3 power plant for use in cooling towers or is discharged to Sandia Canyon adjacent to the power plant under an NPDES permit and groundwater discharge plan. Under normal operating conditions, the solids from this process are dried in beds at the Sanitary Wastewater Systems Consolidation Plant and are applied as fertilizer as authorized by the existing NPDES permit.

4.2.12.6 Waste Minimization

LANL's Environmental Stewardship Office manages LANL's pollution prevention program. This is accomplished by eliminating waste through source reduction or material substitution; by recycling potential waste materials that cannot be minimized or eliminated; and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. The achievements and progress have been updated at least annually. Implementing pollution prevention projects reduced the total amount of waste generated at LANL in 1999 by approximately 2,459 cubic meters (3,216 cubic yards). Examples of pollution prevention projects completed in 1999 at LANL include reduction of low-level radioactive waste and mixed low-level radioactive waste by 116 cubic meters (152 cubic yards) by decontaminating waste metal and reduction of transuranic waste by 3 cubic meters (4 cubic yards) by using improved nondestructive assay instrumentation, which enabled the measurement and characterization of waste as either transuranic or low-level radioactive waste (DOE 2000i).

4.2.12.7 Waste Management PEIS Records of Decision

The *Final Waste Management Programmatic Environmental Impact Statement for Managing, Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (*Waste Management PEIS*) Records of Decision affecting LANL are shown in **Table 4–18**. Decisions on the various waste types were announced in a series of Records of Decision that have been published on the *Waste Management PEIS* (DOE 1997a). The hazardous waste Record of Decision was published on August 5, 1998 (63 FR 41810), and the low-level radioactive and mixed low-level radioactive waste Record of Decision was published on February 18, 2000 (65 FR 10061). The hazardous waste Record of Decision states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of the nonwastewater hazardous waste, with the Oak Ridge Reservation and the Savannah River Site continuing to treat some of their own nonwastewater hazardous waste on site in existing facilities, where this is economically feasible. The low-level radioactive waste and mixed low-level radioactive waste Record of Decision states that, for the management of low-level radioactive waste, minimal treatment will be performed at all sites, and disposal will continue, to the extent practicable, on site at INEEL, LANL, the Oak Ridge Reservation, and the Savannah River Site. In addition, Hanford and NTS will be available to all DOE sites for low-level radioactive waste disposal. Mixed low-level radioactive waste will be treated at Hanford, INEEL, the Oak Ridge Reservation, and the Savannah River Site and disposed of at Hanford and NTS. More detailed information concerning DOE's decisions for the future configuration of waste management facilities at LANL is presented in the hazardous waste and the low-level radioactive and mixed low-level radioactive waste Records of Decision.

Table 4–18 Waste Management PEIS Records of Decision Affecting LANL

Waste Type	*Preferred Action*
Low-level radioactive	DOE has decided to treat LANL's low-level radioactive waste on site and continue onsite disposal. [a]
Mixed low-level radioactive	DOE has decided to regionalize treatment of mixed low-level radioactive waste at the Hanford Site, INEEL, the Oak Ridge Reservation, and the Savannah River Site. DOE has decided to ship LANL's mixed low-level radioactive waste to either the Hanford Site or NTS for disposal. [a]
Hazardous	DOE has decided to continue to use commercial facilities for treatment of most of LANL's nonwastewater hazardous waste. [b]

[a] From the Record of Decision for low-level radioactive and mixed low-level radioactive waste (65 FR 10061).
[b] From the Record of Decision for hazardous waste (63 FR 41810).
Source: 65 FR 10061, 63 FR 41810.

4.3 SANDIA NATIONAL LABORATORIES/NEW MEXICO

SNL/NM is located within KAFB, approximately 11 kilometers (7 miles) southeast of downtown Albuquerque, New Mexico (see **Figure 4–12**). Albuquerque is located in Bernalillo County, in north central New Mexico, and is the state's largest city, with a population of approximately 420,000. The Sandia Mountains rise steeply immediately north and east of the city, with the Manzanita Mountains extending to the southeast. The Rio Grande runs southward through Albuquerque and is the primary river traversing central New Mexico. Nearby communities include Rio Rancho and Corrales, each located about 25 kilometers (15.5 miles) to the northwest. The Pueblo of Sandia and town of Bernalillo are located 34 kilometers (21 miles) and 39 kilometers (24 miles), respectively, to the north. The Pueblo of Isleta and towns of Los Lunas and Belen are located 17 kilometers (10.5 miles), 28 kilometers (17.5 miles), and 45 kilometers (28 miles), respectively, to the southwest.

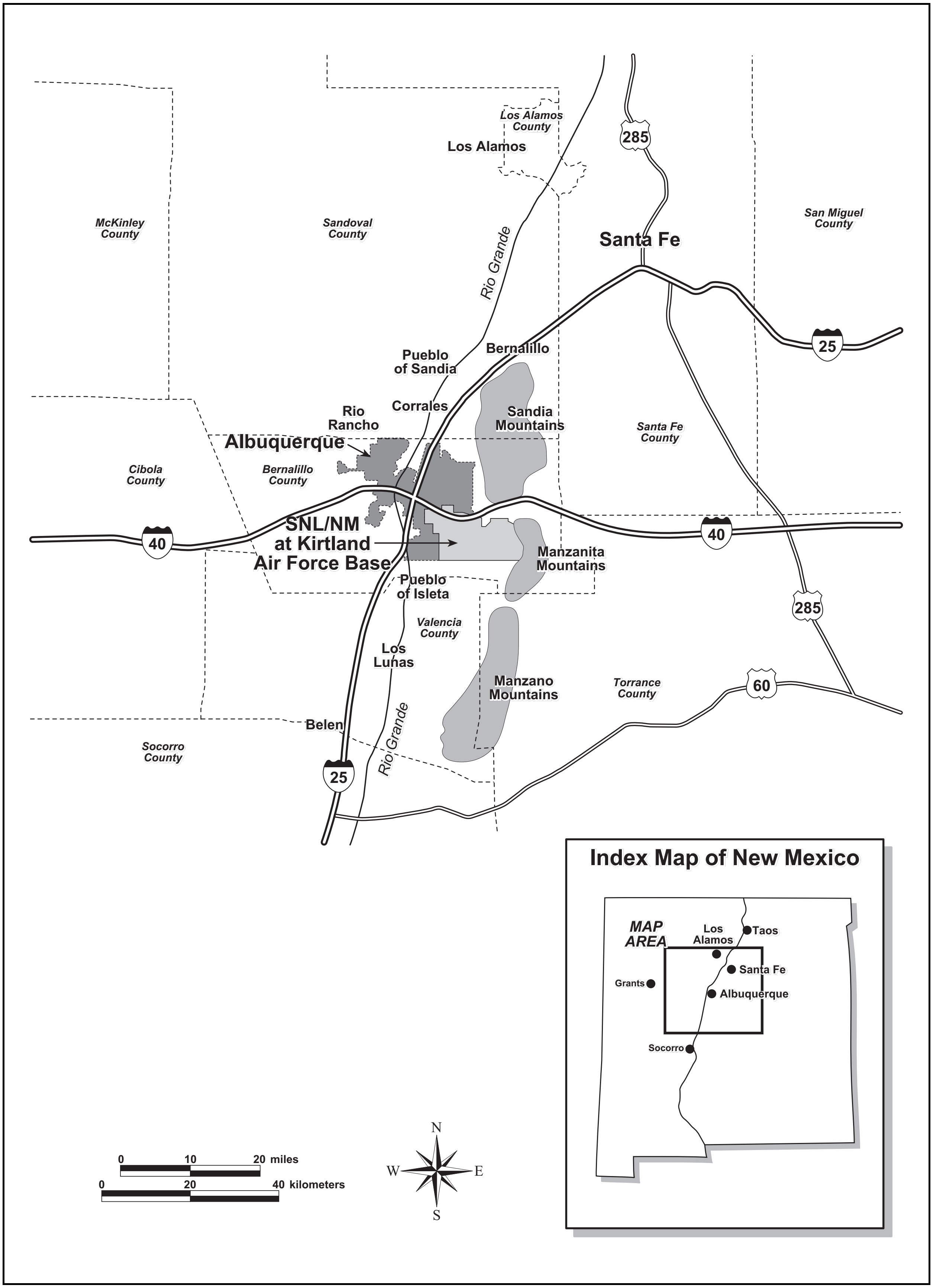


Figure 4–12 Location of SNL/NM

SNL/NM uses approximately 3,560 hectares (8,800 acres) of Federal land on KAFB which is administered by DOE's NNSA. There are approximately 670 buildings at SNL/NM, plus a number of structures associated with outdoor test areas. DOE missions at SNL/NM are conducted within five TAs, as well as several outdoor test areas. TAs comprise the basic geographic configuration of SNL/NM (see **Figure 4–13**). TA-I is the main administration and site support area and contains several laboratories. TA-II consists primarily of support service facilities along with the new Explosive Components Facility, several active and inactive waste management facilities, and vacated facilities replaced by the Explosive Components Facility. TA-III is devoted primarily to physical testing; TA-IV contains primarily accelerator operations; and TA-V contains primarily reactor facilities. The Coyote Test Field and the Withdrawn Area are used for outdoor testing (DOE 1999f). Unless otherwise referenced, the following descriptions of the affected environment at SNL/NM and TA-V are based all or in part on information provided in the *SNL/NM SWEIS* (DOE 1999f), which is incorporated by reference.

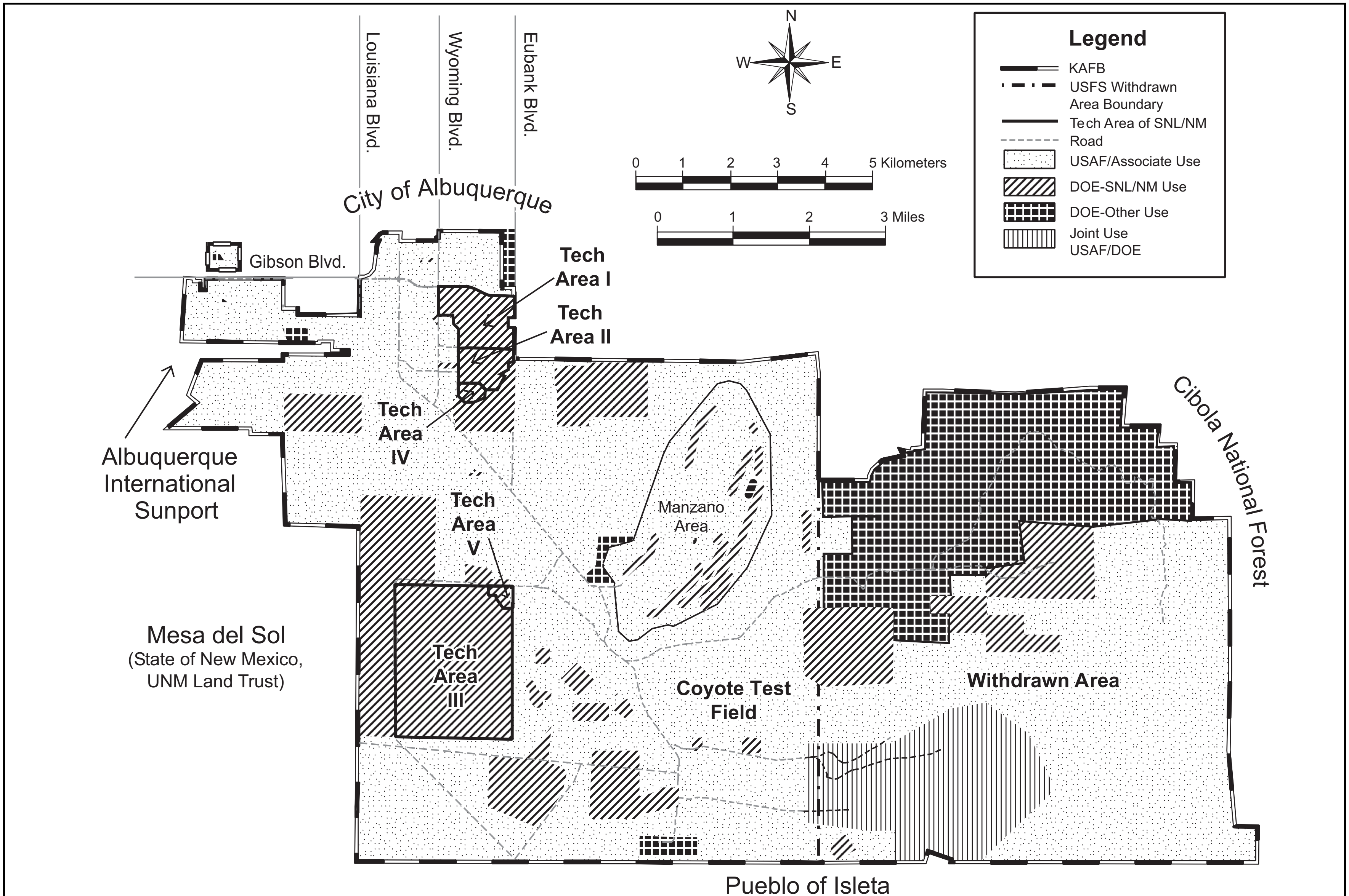
4.3.1 Land Resources

4.3.1.1 Land Use

KAFB is an Air Force Materiel Command Base located southeast of Albuquerque, New Mexico. KAFB shares facilities and infrastructure with several organizations, including DOE. It is comprised of 20,865 hectares (51,559 acres) of land, including portions of Cibola National Forest withdrawn in cooperation with the U.S. Forest Service. KAFB is geographically bounded by the Pueblo of Isleta to the south, the Albuquerque International Sunport and lands held in trust by the State of New Mexico to the west, and the city of Albuquerque to the north (see Figure 4–13). The eastern boundary lies within the Manzanita Mountains. Land owned by the Pueblo of Isleta is a wide expanse of open rangeland. Lands held in trust by the State of New Mexico include the Mesa del Sol area, which is a 5,260-hectare (13,000-acre) parcel of vacant land that has been annexed by the city of Albuquerque and will be developed in the future. The city of Albuquerque has the most influence on land use adjacent to the north-northwestern boundary of KAFB. The city has experienced steady growth in these areas characterized by single-family and multi-family residential dwellings, mixed/minor commercial establishments, and light industrial/wholesale operations. The northeast boundary of KAFB is surrounded almost entirely by Cibola National Forest.

Land ownership on KAFB is divided primarily among the U.S. Air Force (49 percent), the U.S. Forest Service (31 percent), DOE (6 percent), and the Bureau of Land Management (5 percent). The majority of acreage comprising the western half of KAFB is owned by the U.S. Air Force. DOE also owns land in this area, which is occupied almost entirely by SNL/NM facilities. Some land in the southwestern half of the base is owned by the Bureau of Land Management and has been withdrawn by the U.S. Air Force. The eastern portion of KAFB, commonly referred to as the Withdrawn Area, consists of more than 8,288 hectares (20,480 acres) of U.S. Forest Service land within the Cibola National Forest that has been withdrawn by the U.S. Air Force and DOE in separate actions.

The U.S. Air Force and DOE are the principal land users within the KAFB. Land use is established through coordination and planning agreements between these agencies. On matters involving the Withdrawn Area, the U.S. Forest Service is also involved. The U.S. Air Force operates on much of its own land, as well as on property within its portion of the Withdrawn Area. DOE owns only a small portion of the land it needs, and is required to conduct many of its activities under permit on land owned or withdrawn by the U.S. Air Force or within its section of the Withdrawn Area. DOE also leases land adjacent to KAFB to support SNL/NM activities. SNL/NM facilities and operations encompass the majority of DOE's land use requirements on KAFB. Other DOE-funded facilities located on KAFB include the Lovelace Respiratory Research Institute; the Nonproliferation and National Security Institute; the Transportation Safeguards Division; Federal



Source: DOE 1999f.

Figure 4–13 Land Use at KAFB

Manufacturing and Technology/New Mexico; Ross Aviation, Inc.; the Energy Training Center; and the DOE/Albuquerque Operations Office.

There is no single comprehensive land use plan for KAFB; however, existing land use designations and future planning scenarios are addressed in documents produced by the U.S. Air Force, the U.S. Forest Service, and SNL/NM. As discussed in the *SNL/NM SWEIS*, these documents include the *KAFB Comprehensive Plan*, the *Cibola National Forest Land and Resource Management Plan*, the *SNL Sites Comprehensive Plan*, and *SNL Sites Integrated Master Plan*.

The primary land use at SNL/NM fits into the industrial/research park category. This category coincides with the preliminary future use scenarios presented to the Citizens Advisory Board of the Future Use, Logistics, and Support Working Group. KAFB land used by the U.S. Air Force is also designated for industrial use, but includes a broader range of other uses such as residential, recreational, and medical activities that are associated with day-to-day base operations. Additionally, large areas of land within KAFB, particularly in the Withdrawn Area, do not support specific facilities or programs, but are used as safety zones in association with U.S. Air Force and DOE testing and training activities. The five SNL/NM TAs cover approximately 1,036 hectares (2,560 acres), or 87 percent of DOE-owned land. The land area covered by TAs-I through V is 142 hectares (350 acres), 85 hectares (210 acres), 765 hectares (1,890 acres), 34 hectares (85 acres), and 10 hectares (25 acres), respectively.

TA-V is located adjacent to the northeast corner of TA-III (see Figure 4–13). In addition to DOE-owned lands within the boundaries of TA-V, approximately 2.4 hectares (2 acres) are permitted to DOE by the U.S. Air Force to provide additional security. TA-V is a relatively small research area consisting of about 35 closely grouped structures with little open space (see Figure 3–7). Experimental and engineering nuclear reactors are located within the site. Approximately 159 personnel work in the area.

4.3.1.2 Visual Resources

The surrounding visual characteristics of SNL/NM consist of mostly flat, gently sloping grassland to the west and mountainous terrain to the east. Key landforms that dominate views in the general area include the Four Hills Formation, the Manzanita Mountains, and the Manzano Mountains further south. From areas of Albuquerque nearest KAFB, views to the east and southeast are limited by the Four Hills Formation and surrounding foothills of the Manzano area. Views to the south partially consist of KAFB facilities, the Albuquerque International Sunport, and open rangeland. In general, the terrain features associated with the western portion of KAFB are not particularly distinctive. The eastern half, however, exhibits greater visual variety due to its mountain and canyon topography. Most SNL/NM facilities are well within the KAFB boundary. Because of their location and the surrounding terrain characteristics, most facilities are not visible from roads and areas with public access. Distant views of TA-I are possible from eastbound Interstate 40, but they are brief and show limited detail. Views from Interstate 25 consist of background landscapes only.

Development is the most apparent modern alteration of the natural environment on KAFB affecting visual resources. Much of this activity is striking in nature and characterized by an urban setting with large buildings, extensive roadways, utility structures, parking lots, and other developed areas. The northwestern portion of KAFB, which includes SNL/NM TAs-I, -II and -IV, is the most populated and densely developed area that exemplifies these conditions. Although limited in size, TA-V is also heavily developed. TA-III has a more limited and scattered development pattern, but similarly exhibits a variety of man-made modifications that affect the visual environment. Developed areas of SNL/NM have a Bureau of Land Management Visual Resource Contrast Class IV rating (i.e., management activities dominate the view and are the major focus of viewer attention). SNL/NM has initiated Campus Design Guidelines in an effort to give more consideration to visual impacts. The Coyote Test Field and particularly the Withdrawn Area are more sparsely developed. Undeveloped and sparsely developed lands within KAFB have a Visual Resource Contrast rating of Class II or III. Management activities within these classes may be seen but should not dominate the view.

TA-V, which, as noted above, contains 35 closely grouped structures within a relatively small area, has a Class IV Visual Resource Management Contrast rating.

4.3.2 Site Infrastructure

Site infrastructure characteristics for SNL/NM and KAFB are summarized in **Table 4–19**.

Table 4–19 SNL/NM and KAFB Sitewide Infrastructure Characteristics

Resource	*Site Usage* [a]	*Site Capacity* [a]
Transportation		
Roads (kilometers)	72 [b]	Not applicable
Railroads (kilometers)	0	Not applicable
Electricity		
Energy (megawatt-hours per year)	504,000	1,100,000
Peak load (megawatts)	69 [c]	125
Fuel		
Natural gas (cubic meters per year)	35,700,000	65,100,000
Liquid fuels	1,500,000	Not applicable
Coal (metric tons per year)	0	0
Water (liters per year)	4,400,000,000	7,600,000,000

[a] Site usage and capacity values are for all of KAFB, of which SNL/NM is a part, with the exception of liquid fuels usage which is available for SNL/NM only.
[b] Includes paved and unpaved roads.
[c] Peak load estimated from site-wide electrical energy capacity assuming peak load is 120 percent of average demand.
Sources: DOE 1999f.

4.3.2.1 Ground Transportation

The site maintains about 32 kilometers (20 miles) of paved roads and 40 kilometers (25 miles) of unpaved roads (see Table 4–19). There are also approximately 65 hectares (160 acres) of paved service and parking areas. Rail facilities are not available on KAFB. Local and linking transportation systems, including roadways, are detailed in Section 4.3.9.4.

4.3.2.2 Electricity

Electrical service to KAFB and SNL/NM is supplied by Public Service Company of New Mexico. The electrical transmission system is a high-voltage (46-kilovolt) overhead transmission system from the Public Service Company of New Mexico to the various substations within SNL/NM. SNL/NM maintains approximately 185 kilometers (115 miles) of electrical transmission/distribution lines and 26 master unit substations that distribute all its electrical power. The Public Service Company of New Mexico provides power to SNL/NM through the Eubank substation, located east of SNL/NM. A second source of power from the Public Service Company of New Mexico is currently under construction south of TA-IV. South of Tijeras Arroyo, KAFB owns and maintains the transmission lines that support SNL/NM facilities. The system has experienced outages to facilities in TAs-III, -IV, and -V and the Coyote Test Field. Improvements to the system are anticipated pending completion of an upgrade project.

The KAFB electrical capacity is about 1.1 million megawatt-hours per year (see Table 4–19). In 1996, SNL/NM used 197,000 megawatt-hours of electricity. The rest of KAFB used 307,000 megawatt-hours of electricity in 1996. Peak load usage at SNL/NM is 32 megawatts (DOE 1996f). It is estimated that KAFB and SNL/NM have a combined peak load demand of about 69 megawatts. Site-wide peak load capacity is 125 megawatts. Electric power usage at TA-V is estimated to be approximately 5,000 mega-watt-hours annually (SNL/NM 2001a).

4.3.2.3 Fuel

Natural gas supplied by the Public Service Company of New Mexico to SNL/NM and KAFB is the primary heating fuel used at the SNL/NM steam plant. The source of natural gas to KAFB and the SNL/NM central steam plant is a high-pressure line that enters KAFB near the intersection of Pennsylvania Avenue and Gibson Boulevard. SNL/NM also maintains 7.2 kilometers (4.5 miles) of gas line. Natural gas is also supplied to self-contained boilers at SNL/NM facilities in TAs-I, -II, and -IV, which are not on the steam distribution system. Laboratories also use natural gas in many of the buildings for heating and experiments. Diesel fuel is used as an emergency backup during natural gas pressure interruptions.

The KAFB natural gas delivery system has a capacity of about 65 million cubic meters (2.3 billion cubic feet) per year (Table 4–19). In 1996, SNL/NM used approximately 16.4 million cubic meters (580 million cubic feet) of natural gas. Other KAFB users accounted for about 19.3 million cubic meters (680 million cubic feet) of additional natural gas usage. SNL/NM use of propane was about 1.4 million liters (370,000 gallons) and is used in TAs-III and -V and in other remote locations. Diesel fuel use was approximately 57,000 liters (15,000 gallons) in 1996. Annual propane and fuel oil use by other KAFB users is not available. TA-V uses approximately 142,000 cubic meters (5 million cubic feet) of natural gas and about 189,000 liters (50,000 gallons) of propane annually (SNL/NM 2001a).

4.3.2.4 Water

KAFB owns and operates the water supply and distribution system, which includes piping, the main booster pump station, storage reservoirs, and wells. Water is supplied from wells located generally in the northwestern portion of KAFB that withdraw from the Santa Fe Group (see Section 4.3.6.2). Neither the existing water service from KAFB to SNL/NM, nor most major SNL/NM facilities are metered. The system has a capacity of approximately 7.6 billion liters (2 billion gallons) per year (Table 4–19). In 1996, SNL/NM used approximately 1.7 billion liters (440 million gallons) of water. Other KAFB users accounted for about 2.7 billion liters (710 million gallons) of additional water usage. TA-V uses about 6.1 million liters (1.6 million gallons) of water per year (SNL/NM 2001a).

4.3.3 Air Quality

The climate at SNL/NM and in the surrounding region is semiarid. The ambient temperatures in the region are characteristic of high-altitude, dry continental climates. Winter daytime temperatures average approximately 10 °C (50 °F), with nighttime temperatures often dropping into the low teens. Summer daytime temperatures generally do not exceed 32 °C (90 °F), except in July, when average maximum temperatures reach 34 °C (93 °F). The Albuquerque basin is characterized by low precipitation, averaging between 19 and 25 centimeters (7.5 and 10 inches) per year. Most of this precipitation falls from July through September and usually occurs from thunderstorm activities and the intrusion of warm, moist tropical air from the Pacific Ocean. The storms are accompanied by localized heavy wind gusts. Winter months are typically dry, with less than 5 centimeters (2 inches) of precipitation and limited snowfall. The average annual relative humidity is about 43 percent. New Mexico has one of the greatest frequencies of lightning in the United States. Tornadoes are uncommon in the Albuquerque basin.

Temperature, relative humidity, and precipitation do not vary dramatically across the region. Daily and seasonal wind patterns occur near the mountains and plateau. Daytime up-slope flows are usually coupled with downslope flows during the night. Strong springtime, easterly winds occur near canyons, and light north-south flows occur in the Rio Grande Valley. In general, areas closer to the mountains or canyons experience more frequent winds from an easterly direction at night. Daytime wind patterns are not as pronounced, but generally flow toward the mountains or along the Rio Grande Valley. The Rio Grande Valley experiences the most frequent calm conditions and the lowest average wind speed. In most areas, the nighttime wind direction frequency produces the most dominant average annual direction. The average annual wind speed is 4 miles per second (8.9 miles per hour) (WRCC 2001).

4.3.3.1 Nonradiological Releases

SNL/NM is in the Albuquerque Middle Rio Grande Intrastate Air Quality Control Region (#152) (40 CFR 81.83). The EPA has classified this region as better than national standards for sulfur dioxides; unclassifiable/attainment for ozone; unclassifiable for PM_{10}; unclassifiable or better than national standards for nitrogen dioxide; attainment (maintenance area) for carbon monoxide; and not designated for lead (40 CFR 81.332). The nearest Prevention of Significant Deterioration Class I area to SNL/NM is Bandelier National Monument, which is located 80 kilometers (50 miles) to the north-northeast.

The primary stationary sources of criteria pollutants are the steam plant boilers (which represent more than 90 percent of the total emissions of criteria pollutants), Building 862 generators, and the fire testing facilities located at the Lurance Canyon Burn Site. Other sources are spatially separated, thereby contributing minimal impacts. Emissions of hazardous chemical air pollutants include those from facilities that release chemicals to the atmosphere and from operations at the burn site.

The steam plant produces heat for buildings in TA-I and the eastern portion of KAFB. SNL/NM has four standby generators, each with a 600-kilowatt capacity. These diesel-fired generators are in TA-I, Building 862. The generators have a local air quality permit limiting operation to 500 hours per year per generator. They are started monthly for maintenance and testing, as well as during electrical power outages in TA-I. The fire testing facilities (Lurance Canyon Burn Site) include a number of open pools, the Smoke Emission Reduction Facility, and the Small Wind-Shielded Facility. The open pools emit directly to the atmosphere, while the two facilities are closed and emit through exhaust stacks. The fire testing facilities are used to test the response of shipping containers, aerospace components, and other items to high-temperature conditions. These facilities typically average 42 tests per year; each test lasts about 30 minutes, although some can last as long as 4 hours. Mobile sources (motor vehicles) are a major source of criteria pollutant emissions in and around SNL/NM. **Table 4–20** summarizes the emissions associated with these facilities for 1996, as well as volatile organic compound and hazardous air pollutant emissions from the entire site.

Table 4–20 Estimated Air Emissions from Stationary Sources at SNL/NM in 1996

Pollutant	*1996 Emissions (metric tons per year)*
Carbon monoxide	13.8
Nitrogen oxides	140
PM_{10}	3.31
Sulfur dioxide	0.29
Volatile organic compounds	3.69
Hazardous air pollutants	2.2

PM_{10} = Particulate matter less than or equal to 10 microns in aerodynamic diameter.
Source: DOE 1999f.

Volatile organic compound and hazardous air pollutant emissions also come from laboratories, miscellaneous chemical operations, and the fire testing facilities. Chemical uses and the corresponding emissions occur in each TA and in the outlying test areas. In 1996, hazardous air pollutant emissions associated with chemical users were 2.2 metric tons (2.4 tons). Volatile organic compound emissions for 1996 were approximately 3.7 metric tons (4.07 tons).

Few industrial emission sources exist in the region. Primary air pollutant emissions in the region result from using motor vehicles, the seasonal use of wood-burning stoves and fireplaces, and open burning activities.

Air quality for SNL/NM is governed by regulations promulgated locally by the Albuquerque/Bernalillo County Air Quality Control Board and federally by the EPA. The EPA has delegated authority for regulating sources under the Clean Air Act to the State of New Mexico. In turn, the State of New Mexico has delegated authority for regulating sources to the Control Board, located in Bernalillo County.

The Albuquerque/Bernalillo County Air Quality Control Board promulgates regulations in 20 New Mexico Administrative Code 11 for compliance with the Clean Air Act, as well as applicable state and local air quality requirements. The Albuquerque Environmental Health Department Air Quality Division administers the regulations promulgated by the Control Board. The New Mexico Environmental Improvement Board has established ambient air quality standards (20 New Mexico Administrative Code 2.3) that are generally more stringent than the Federal standards and that incorporate additional standards for hydrogen sulfide and total reduced sulfur. In addition to the criteria pollutants provisions, the EPA established in 40 CFR Part 61 the National Emission Standards for Hazardous Air Pollutants (NESHAP) and Title III of the 1990 Clean Air Act Amendments, which define hazardous air pollutants. The primary nonradiological pollutants considered in this EIS are criteria pollutants and hazardous air pollutants. Hazardous air pollutants include the 188 hazardous air pollutants defined by the EPA in Title III of the Clean Air Act. Also included are other potentially toxic chemical air pollutants for which occupational exposure limits have been defined by various organizations, including those chemicals categorized as volatile organic compounds (any organic compound that participates in atmospheric photochemical reactions except those designated by the EPA administrator as having negligible photochemical reactivity). Only those hazardous air pollutants that would be of concern for any alternatives at this site are discussed here.

Monitoring stations throughout the Albuquerque Basin are operated by the Albuquerque Environmental Health Department and the New Mexico Environment Department to measure criteria pollutants, including carbon monoxide, nitrogen dioxide, PM_{10}, and ozone. These monitoring stations do not measure lead or sulfur dioxide. An additional station, the Criteria Pollutant Monitoring Station located in TA-I, measures lead and sulfur dioxide.

In addition to regional ambient air quality monitoring for criteria pollutants, SNL/NM operates six onsite monitoring stations for PM_{10}. Monitoring results indicate that sampling locations closer to the most populated areas of SNL/NM generally reveal higher PM_{10} concentrations. In addition, PM_{10} concentrations generally increase during the windy season due to blowing soil particles. Additional information on criteria pollutant concentrations at monitoring stations in TA-I is presented in the *SNL/NM SWEIS* and the *1999 Annual Site Environmental Report, Sandia National Laboratories, New Mexico* (SNL/NM 2001b). Measurements at these stations include contributions of criteria pollutants from the nearby SNL/NM emission sources. **Table 4–21** compares air pollutant concentrations which are considered to be representative of background conditions near SNL/NM to applicable Federal (40 CFR Part 50) and state (20 New Mexico Administrative Code 2.3) standards for each pollutant. These values include monitoring data in the Albuquerque Basin during 1999 and particulate matter values recommended by the state agency. Monitoring data in the Albuquerque Basin and at monitors within the SNL/NM in some cases show higher values. Air quality standards were not exceeded in 1999 in the Albuquerque Basin, except the PM_{10} standards were exceeded at one onsite monitor where values of 50.6 micrograms per cubic meter, annual average, and 188 micrograms per cubic meter, 24-hour average were reported. Onsite concentrations were all below threshold standards. Maximum onsite PM_{10} concentrations were 16.6 and 66 micrograms per cubic meter for annual and 24-hour averaging at the KUPM monitor northwest of TA-V (SNL/NM 2001b, EPA 2001).

Table 4–21 Comparison of Background Ambient Air Concentrations With Applicable National and New Mexico Ambient Air Quality Standards [a]

Pollutant	*Averaging Period*	*Most Stringent Standard [b] (micrograms per cubic meter)*	*Maximum Ambient Air Concentration (micrograms per cubic meter)*
Carbon monoxide	8 hours 1 hour	8,280 12,500	4,660 [c] 5,520 [c]
Lead	Quarterly	1.5	0.002 [d]
Nitrogen dioxide	Annual 24 hours	78.1 156	26.1 [e] 46 [e]
Ozone	1 hour	196	145 [f]
PM_{10}	Annual 24 hours	50 150	30 [g] 30 [g]
Sulfur dioxide	Annual 24 hours 3 hours	43.5 217 1,090	0.12 [h] 1.7 [h] 13.5 [h]
Total suspended particulates	Annual 24 hours	60 150	30 30

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.

[a] New Mexico also has ambient standards for total reduced sulfur and hydrogen sulfide. There is no monitoring data for these compounds and they are not pollutants of concern at SNL/NM.

[b] The more stringent of NAAQS and the state standard. The annual standards are not to be exceeded. Short-term standards may be exceeded, generally once, before a violation must be reported. The preamble of the state regulation (Section 108) allows excesses over short periods of time due to unusual meteorological conditions. Standards and monitored values for pollutants other than particulate matter are stated in parts per million (ppm). These values have been converted to micrograms per cubic meter ($\mu g/m^3$) with appropriate corrections for temperature (21 °C [70 °F]) and pressure (elevation 5,400 feet) following New Mexico dispersion modeling guidelines (revised 1998) (NMAQB 1998).

[c] 1999 maximum background concentrations from monitoring stations 350011003-1 or 350010023-1.

[d] 1999 maximum background concentration at onsite monitoring station (CPMS).

[e] 1999 annual concentration at Albuquerque monitor (350010023-1) 25 micrograms per cubic meter plus contribution from the Cobisa Power Plant (1.1 micrograms per cubic meter) (DOE 1999f).

[f] Highest 1-hour ozone monitoring value at the CPMS site in 1999.

[g] Background PM_{10} values for 24-hour and annual PM_{10} cumulative impacts from NMAPCB (DOE 1999f).

[h] Background concentrations resulting from operation of the Cobisa Power Plant (DOE 1999f).

Source: DOE 1999f, EPA 2001, SNL/NM 2001b.

The ambient air concentrations attributable to sources at SNL/NM are presented in **Table 4–22**. These concentrations are based on the No Action concentrations presented in the *SNL/NM SWEIS* and include the contribution from the Cobisa Power Station and the various small sources expected to be operational by 2008. These concentrations are used as the baseline concentration from SNL/NM activities in the cumulative analysis (Section 5.3.14). These concentrations, when combined with background concentrations, (Section 5.3.14) are below the ambient air quality standards. Concentrations of hazardous and toxic compounds are below regulatory standards and human health guidelines as described in the *SNL/NM SWEIS*.

Table 4–22 Modeled Ambient Air Concentrations from SNL/NM Sources

Pollutant	*Averaging Period*	*Most Stringent Standard* [a] *(micrograms per cubic meter)*	*Concentration* [b] *(micrograms per cubic meter)*
Carbon monoxide	8 hours 1 hour	8,280 [c] 12,500 [c]	78.4 119
Nitrogen dioxide	Annual 24 hours	78.1 [c] 156 [d]	10 103.7
Ozone	1 hour	196 [e]	(f)
PM_{10}	Annual 24 hours	50 [c] 150 [c]	11.4 114.2
Sulfur dioxide	Annual 24 hours 3 hours	43.5 [c] 217 [c] 1,090 [c]	1.7 12.2 21.1
Total suspended particulates	Annual 24 hours	60 [c] 150 [c]	11.4 114

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. NAAQS (40 CFR Part 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic PM_{10} mean standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] Concentrations are based on No Action modeled concentrations presented in the *SNL/NM SWEIS* (DOE 1999f), which occur at a receptor at the National Atomic Museum outside the SNL/NM fence line.

[c] Federal and state standard.

[d] State standard.

[e] Federal 8-hour standard is currently under litigation.

[f] Not directly emitted or monitored by the site.

PM_{10} = Particulate matter less than or equal to 10 microns in aerodynamic diameter.

Note: NAAQS also include standards for lead. No sources of lead emissions have been identified for any alternative evaluated. Emissions of hazardous air pollutants not listed here have been identified at SNL/NM, but are not associated with any of the alternatives evaluated. The EPA revised the ambient air quality standards for particulate matter and ozone in 1997 (62 FR 38856, 62 FR 38652); however, these standards are currently under litigation, but could become enforceable during the life of this project.

Sources: 40 CFR Part 50; DOE 1999f.

4.3.3.2 Radiological Releases

In 1999, the highest activities found in SNL/NM's atmospheric emissions were primarily the result of argon and tritium. These radionuclides generally have been the most significant releases over the past 10 years. The major radionuclide species and curies released from SNL/NM are listed in **Table 4–23**. There was a total of 17 point sources and 3 diffuse sources (landfills) listed in the 1999 NESHAP report; 4 of 20 facilities reported zero emissions.

There are three NESHAP sources in TA-V. Two facilities had reportable NESHAP emissions in 1999. One, the Annular Core Research Reactor, is used to perform in-pile experiments for severe reactor accident research projects. In 1997, the configuration was converted to support the Medical Isotope Production Project, which will produce radiopharmaceuticals. Argon-41, an air activation product, was the only radionuclide released from this source in 1999. The second source is the Sandia Pulsed Reactor, which is used to produce intense neutron bursts for effects testing on materials and electronics. This reactor also emitted only argon-41 in 1999. There were no releases from the Hot Cell Facility (the third source) in 1999. This facility provides full capability to remotely handle and analyze radioactive materials such as irradiated targets.

Table 4–23 Radiological Airborne Releases to the Environment at SNL/NM in 1999[a]

Source	*Technical Area*	*Radionuclide*	*Release (curies)*
Sandia Pulsed Reactor, Building 6590	TA-V	Argon-41	2.30
Annular Core Research Reactor, Building 6588	TA-V	Argon-41	2.99
High-Energy Radioactive Megavolt Electron Source, Building 970	TA-IV	Nitrogen-13	4.08×10^{-4}
Mixed Waste Landfill (diffuse emissions)	TA-III	Tritium (Hydrogen-3)	0.294
Radioactive and Mixed Waste Management Facility, Building 6920	TA-III	Tritium	0.6
Chemical Waste Landfill (diffuse emissions)	TA-III, South	Uranium-238	2.52×10^{-6}
Explosives Components Facility, Building 905	TA-II	Tritium	5.05×10^{-4}
Cleaning and Contamination Central Laboratory, Building 897	TA-I	Carbon-14	3.5×10^{-5}
Neutron Generator Facility, Building 870 - East Annex - North Wing Tritium Envelope	TA-I	 Tritium Tritium	 0.08 2.7
TANDEM Accelerator, Building 884	TA-I	Tritium Nitrogen-13 Fluorine-18	1×10^{-6} 1.85×10^{-5} 1.69×10^{-6}
Radiation Laboratory, Building 827	TA-I	Tritium	1×10^{-5}
Calibration Laboratory, Building 869	TA-I	Tritium	2.6×10^{-5}

[a] Radionuclides with half-lives less than about 10 minutes are not included in the table. Also not included are radionuclides for which less than 10^{-6} curies are released per year. Refer to SNL/NM 2001b for the complete list of airborne releases.
Source: SNL/NM 2001b.

4.3.4 Noise

Baseline sounds at SNL/NM consist of noise generated in and around the surrounding area, mainly from transportation and stationary sources. Activities at and around SNL/NM affect ambient (background) sound. These include aircraft associated with Albuquerque International Sunport and KAFB, vehicular traffic at KAFB, and industrial sources. SNL/NM test programs, including tests of high explosives, rocket motors, and large-caliber weapons and tests producing sonic booms, contribute to the noise baseline. Other noise sources at SNL/NM include industrial and construction activities.

Noise effects to the community depend on the loudness of the sound, the intensity of vibrations, the frequency of the events, and the atmospheric conditions transmitting sound during the event. In most cases, the impulse sound heard outside KAFB resembles a dull thud or a short burst (less than three seconds). The noise baseline (aircraft, traffic, and industrial sources) would mask the sounds produced by most SNL/NM activities.

SNL/NM's ambient background sounds will be relatively consistent. Background sounds produced by generators, air conditioning, ventilation systems, vehicles, and employee activities constitute a substantial sound source during the morning, midday, and evening. The range of background noise levels associated with these sources is from 50 to 70 dBA (day-night average sound level).

SNL/NM testing produces the most perceptible impulse sound levels at TA-III, Coyote Test Field, and other outdoor test facilities. The 1996 baseline frequency of impulse noise events is 1,059 events. Only a small fraction of these events are loud enough to be heard or felt beyond the site boundary. No residential areas on KAFB or in the city of Albuquerque are affected by vibrations expected to be damaging or annoying.

SNL/NM is subject to aircraft noise from the Albuquerque International Sunport and KAFB and from vehicular traffic on KAFB. Aircraft noise is the most prevalent sound because Runway 8-26 is the primary runway for the Albuquerque International Sunport. Aircraft take off and land in an easterly direction on this runway about 75 to 80 percent of the time. Aircraft using this runway fly directly over SNL/NM. Noise abatement procedures to decrease aircraft noise in nearby neighborhoods, such as Ridgecrest and Four Hills, affect SNL/NM. These procedures direct pilots to avoid these neighborhoods by flying over SNL/NM.

Based on Federal Aviation Administration land use compatibility guidelines, adverse effects on people are most likely to occur within the 75-dBA day-night average noise-level area. At the Albuquerque International Sunport, the 65- and 70-dBA noise levels extend beyond the Sunport boundary with KAFB, but not the 75-dBA noise level.

The Air Force Research Laboratory, U.S. Air Force/Explosive Ordnance Disposal, and the Defense Special Weapons Agency detonate explosives on KAFB, and non-SNL/NM agencies perform noise-producing activities at SNL/NM. These activities and the potential for conflicts with land uses are discussed in the *SNL/NM SWEIS*. Motor vehicle noise is prevalent in the more congested areas of KAFB.

The adjoining city of Albuquerque limits sound levels as specified in its Noise Control Ordinance, although this ordinance is not applicable to KAFB. The limitation on noise levels at a residential property line is 55 dBA during the day and 50 dBA at night. Limits are also specified for commercial and industrial properties (City of Albuquerque 2001).

4.3.5 Geology and Soils

SNL/NM is located on the east-central boundary of the 48- by 145-kilometers long (30- by 90-miles long), north-south trending Albuquerque-Belen Basin (SNL/NM 1993). This basin lies within the extensive Rio Grande rift zone (as further described in Section 4.2.5) and the Basin and Range Physiographic Province. KAFB is bordered to the east by the Manzanita Mountains and to the northeast by the Sandia Mountains. The strata beneath the western most portion of KAFB, where the SNL/NM TAs are located, consists primarily of gravels, sands, silts, and clays ranging in age from Quaternary to Miocene (recent to 24 million years old). These consist of alluvium deposited by the ancestral Rio Grande that overlie alluvial fan deposits derived from erosion of the mountains to the east. Immediately overlying the Sante Fe Group across portions of SNL/NM, south of Tijeras Arroyo, is the Ortiz Gravel which is a discontinuous unit with a thickness ranging from 0 to 46 meters (0 to 150 feet) (SNL/NM 1993). The Sante Fe Group is the primary basin-fill material and mainly is composed of unconsolidated sediments (e.g., gravel, sand, silt, clay, and caliche) in the Albuquerque-Belen Basin. The basin-fill deposits and the Sante Fe Group are in turn underlain by Precambrian age (more than 570 million years old) crystalline and Paleozoic age (245 to 570 million years old) marine carbonate bedrock, which also compose the mountains to the east of KAFB (SNL/NM 1993). Additional details about SNL/NM site geology are presented in the *SNL/NM SWEIS*.

Extensive nonmetallic mineral deposits exist in the area in the form of aggregate rock, sand, silt, and clay as components of the basin-fill deposits which underlie KAFB. The potential for metallic mineral deposits also exists within the older bedrock located to the west of the site, as well as placer deposits within the alluvial and colluvial sediments. Evidence of historic placer mining has been identified throughout KAFB as a result of cultural resource surveys.

A number of regional faults cross KAFB just to the east of SNL/NM (Sandia, West Sandia, Manzano, Hubbell Springs, Tijeras, and Coyote Faults) (see **Figure 4–14**). There is no evidence of movement along these faults over the last 10,000 years. Although not active, a determination has not been made as to whether any of these faults should be considered “capable.” A capable fault is one that has had movement at or near

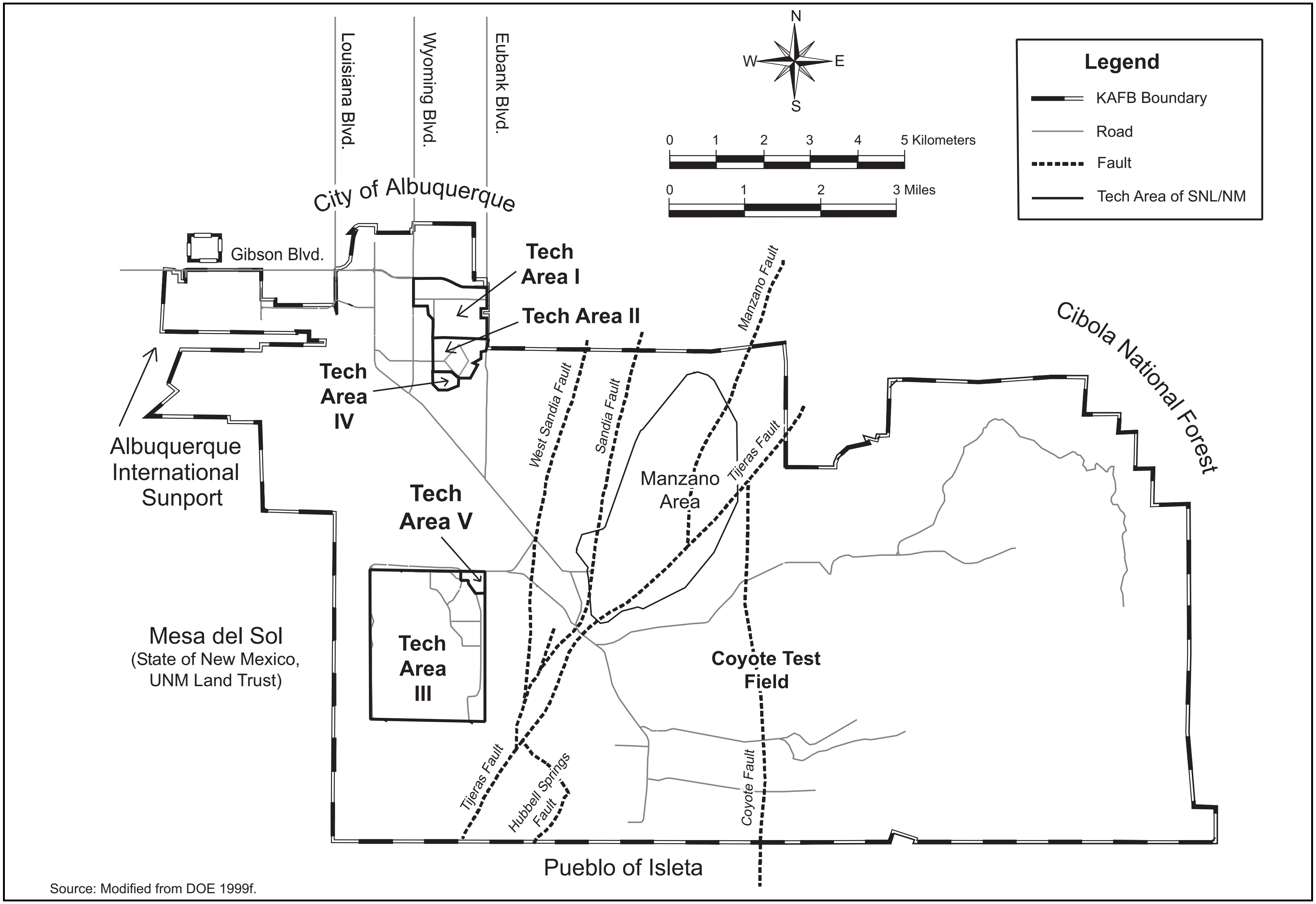


Figure 4–14 Regional Faults at KAFB and SNL/NM

the ground surface at least once within the past 35,000 years or recurrent movement within the past 50,000 years (10 CFR 100, Appendix A).

KAFB and SNL/NM are located in a region with relatively moderate to high seismicity. Modified Mercalli Intensities of up to VII have been reported (DOE 1996f). Over the last 100 years, only three earthquakes have reportedly caused damage in Albuquerque (DOE 1996f). Since 1966, New Mexico has experienced four moderate earthquakes, all approximately magnitude 5 on the Richter scale. Two of these were in Dulce (near the Colorado border in north-central New Mexico), one was in Gallup (near the Arizona border in west-central New Mexico), and one was in Eunice (extreme southeast corner of New Mexico, near the Texas border). The closest of these (Dulce and Gallup earthquakes) were epicentered about 200 kilometers (125 miles) from the site. The largest earthquake experienced in the Albuquerque area occurred on January 4, 1971, and measured magnitude 4.7. There was no appreciable damage to SNL/NM buildings, although some cracks were noted that could have predated the earthquake. This event had a reported Modified Mercalli Intensity of VI at its epicenter, which was located some 12 kilometers (7.4 miles) north-northwest of SNL/NM, as measured from TA-V. Within a radius of 100 kilometers (62 miles) of SNL/NM, a total of 14 significant earthquakes (i.e., having a magnitude of at least 4.5 or a Modified Mercalli Intensity of VI or larger) have been documented, with none centered closer than the January 1971 event (USGS 2001c). Since 1973, 37 earthquakes have been recorded within 100 kilometers (62 miles) of SNL/NM ranging in magnitude from 1.6 to a magnitude 4.8 event in January 1990. The closest of these minor-to-light earthquakes was a July 1985 1.6-magnitude event that was reportedly felt and centered about 6 kilometers (3.7 miles) north of TA-V within KAFB boundaries. All but a few of the remaining 37 earthquakes had epicenters greater than 60 kilometers (37 miles) away. The most recent was a Richter magnitude 4 earthquake that occurred in January 1998 at a distance of 58 kilometers (36 miles) from the site (USGS 2001d).

A nondamaging earthquake producing a Modified Mercalli Intensity of less than III is predicted to have an annual probability of occurrence of 1 in 2 (i.e., once every 2 years) and a damaging event has a probability of 1 in 100 (i.e., once every 100 years) (DOE 1996f). For reference, a comparison of Modified Mercalli Intensity (the observed effects of earthquakes) with measures of earthquake magnitude and ground acceleration is provided in Section F.5.2 (see Appendix F).

As discussed in more detail in Section 4.2.5, the U.S. Geological Survey has developed new earthquake hazard maps that are based on spectral response acceleration. These maps have been adapted for use in the new International Building Code (ICC 2000) and depict maximum considered earthquake ground motion of 0.2- and 1-second spectral response acceleration, respectively, based on a 2 percent probability of exceedance in 50 years (i.e., 1 in 2,500). SNL/NM is calculated to lie within the 0.61g to 0.62g mapping contours for a 0.2-second spectral response acceleration and the 0.17g to 0.18g contours for a 1-second spectral response acceleration. For comparison, the calculated peak ground acceleration for the given probability of exceedance is approximately 0.27g (USGS 2001e).

The potential for future damaging volcanic activity at SNL/NM and the vicinity is considered to be low (DOE 1996f). As for other geologic hazards, slope instability is a concern on steeper slopes such as along water-cut drainages and on mountain slopes to the east of the SNL/NM TAs in the Manzanita Mountains. However, most SNL/NM facilities are constructed on level ground or on the gentle slopes of alluvial fan sediments.

Several soil associations occur across KAFB and are derived primarily from materials eroded from the nearby mountains and deposited as alluvial fans. These include the Bluepoint-Kokan, Madurez-Wink, Tijeras-Embudo, Kolob-Rock outcrop, and Seis-Orthids associations, with the Kolob-Rock outcrop confined to the eastern portion of the site. These soils are moderately to very steep, well-drained, loamy, and stony soils and include basalt, sandstone, and limestone outcrops. The remainder of the soils are generally well the ground surface at least once within the past 35,000 years or recurrent movement within the past 50,000 years (10 CFR 100, Appendix A).

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There are no known capable faults on KAFB. The closest mapped fault to TA-V is the West Sandia Fault, which is located about 1 kilometer (1.6 miles) to the east of the area. Surficial stratigraphy in the southern portion of SNL/NM is dominated primarily by unconsolidated sediments of the Santa Fe Group deposited by the Tijeras Arroyo that attain a thickness of up to 90 meters (300 feet). Soils encompassing TA-V are mapped as Tijeras gravelly fine sandy loam. This unit has a moderate water erosion hazard, but is otherwise suitable for development (SNL/NM 1993).

4.3.6 Water Resources

4.3.6.1 Surface Water

KAFB and SNL/NM are located on the East Albuquerque Mesa, which slopes southwest toward the Rio Grande, the major water drainage in the area. This river flows north to south in the vicinity of KAFB and is located approximately 10 kilometers (6 miles) to the west of the KAFB boundary and SNL/NM facilities (DOE 1996f). Surface water features are depicted in **Figure 4–15**. Surface water from KAFB and SNL/NM, primarily runoff, flows through several major and many small, unnamed arroyos. These rather steep-walled, intermittent stream channels flow primarily only in response to runoff from summer thunderstorms, as runoff from snowmelt in the Manzanita Mountains to the east rarely reaches the lower portions of the arroyos or the Rio Grande. Tijeras Arroyo is the primary drainage feature on KAFB. Tijeras Arroyo enters KAFB just northeast of TAs II and IV and runs southwest before being joined by Arroyo del Coyote at a point about 3.2 kilometers (2 miles) upstream of where Tijeras Arroyo leaves KAFB, and south of TA-IV. Tijeras Arroyo then joins with the Rio Grande at a point approximately 8 kilometers (5 miles) west of the KAFB boundary (DOE 1996f). With the exception of flow from two springs (Coyote Springs and Sol Se Mete), there are no perennial streams or other natural surface water bodies at KAFB. Most runoff and spring seepage infiltrates into the ground and either does not reach a drainage or travels only a relatively short distance down the arroyos and is therefore not conveyed off site.

Onsite arroyos at KAFB and SNL/NM are not classified and, therefore, are protected by default under State of New Mexico surface water quality standards for the uses of livestock watering and wildlife habitat (New Mexico Administrative Code 20.6.4.10). New Mexico standards also apply to the Rio Grande with designated uses for irrigation, limited warm water fishery, livestock watering, wildlife habitat, and secondary contact. Additionally, a stretch of the Rio Grande through Pueblo of Isleta beginning approximately 10 kilometers (6 miles) downstream of the Tijeras Arroyo has additional water quality standards associated with the added designated protected uses for primary contact and primary contact-ceremonial. Due to the ephemeral nature of surface water on KAFB and SNL/NM, it is not a source of municipal, industrial, or irrigation water.

SNL/NM wastewater discharge to arroyos is limited to stormwater runoff. Runoff from TAs-I, -II, and -IV is collected in storm sewer systems that discharge to Tijeras Arroyo. There is no discharge from TAs-III and -V. Storm-water runoff from TAs-I, -II, and -IV is monitored for NPDES permit compliance under the EPA's NPDES Stormwater Multi-Sector General Permit (Permit Number NMR05A181). Monitoring results are reported in the annual site environmental report (SNL/NM 2001b). Industrial and sanitary effluent is collected and discharged to the city of Albuquerque sanitary sewer system in accordance with city permit requirements. As several research reactors in TA-V have the potential to produce radiologically contaminated wastewater, reactor process wastewater from responsible facilities is sent to the Liquid Effluent

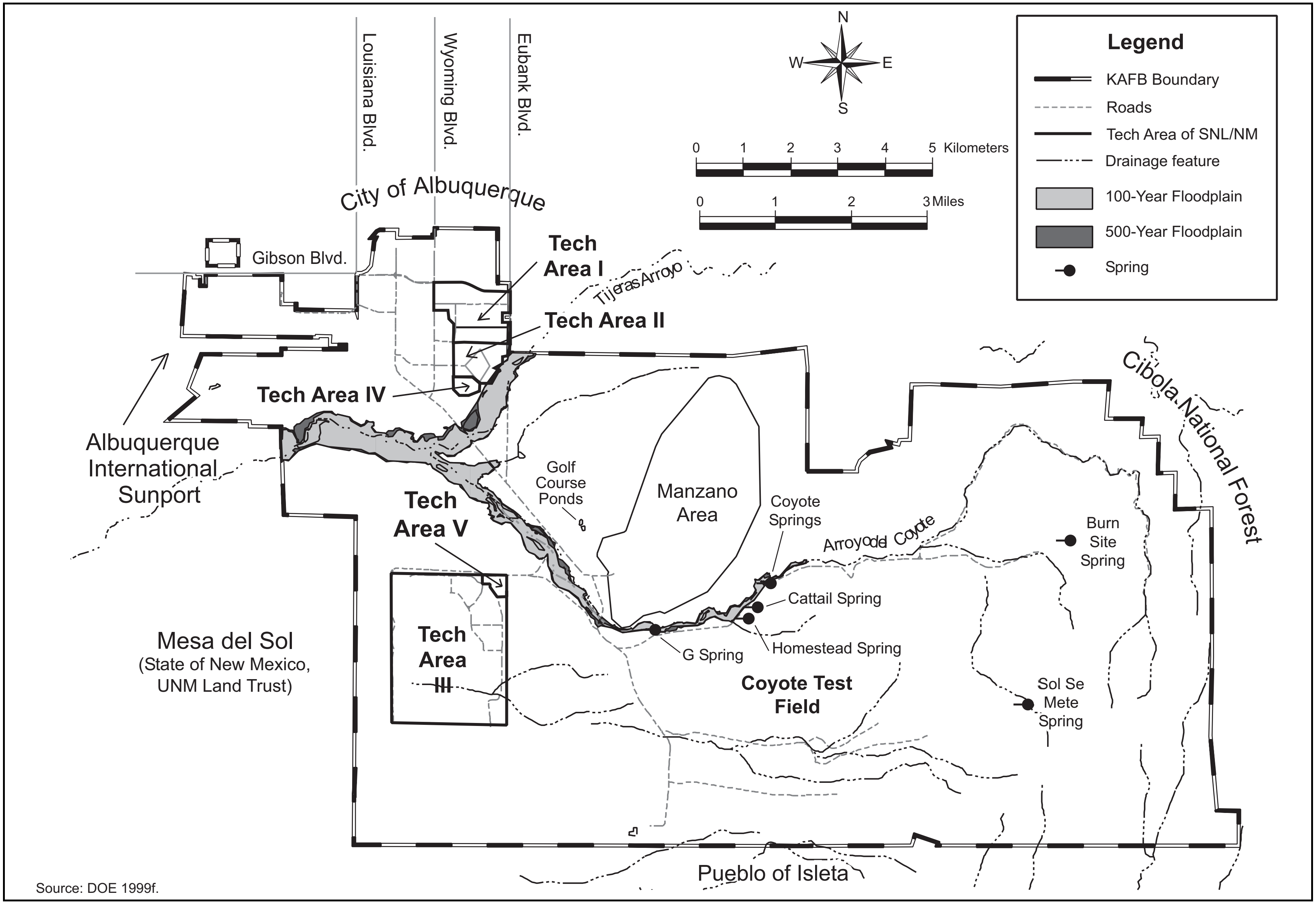


Figure 4–15 Surface Water Features at KAFB

Control System for screening. This system consists of three 18,900-liter (5,000-gallon) holding tanks, an ion-exchange and filter system, and an automatic alarm to alert personnel to the presence of radionuclides. The collected effluent is sampled and analyzed for tritium, gross alpha, gross beta, and gamma activity to ensure that it meets permit limits before being discharged to the sanitary sewer system. SNL/NM discharges about 3 million liters (800,000 gallons) per day of wastewater to the sewer system (SNL/NM 2001b). This wastewater is treated at the Albuquerque sewage treatment plant and ultimately discharged to the Rio Grande at a point about 1.1 kilometers (0.7 miles) north of Tijeras Arroyo. SNL/NM also has three septic systems that service remote locations and are periodically serviced by a licensed contractor (SNL/NM 2001b). Industrial and sanitary effluent management is further discussed in Section 4.3.12.

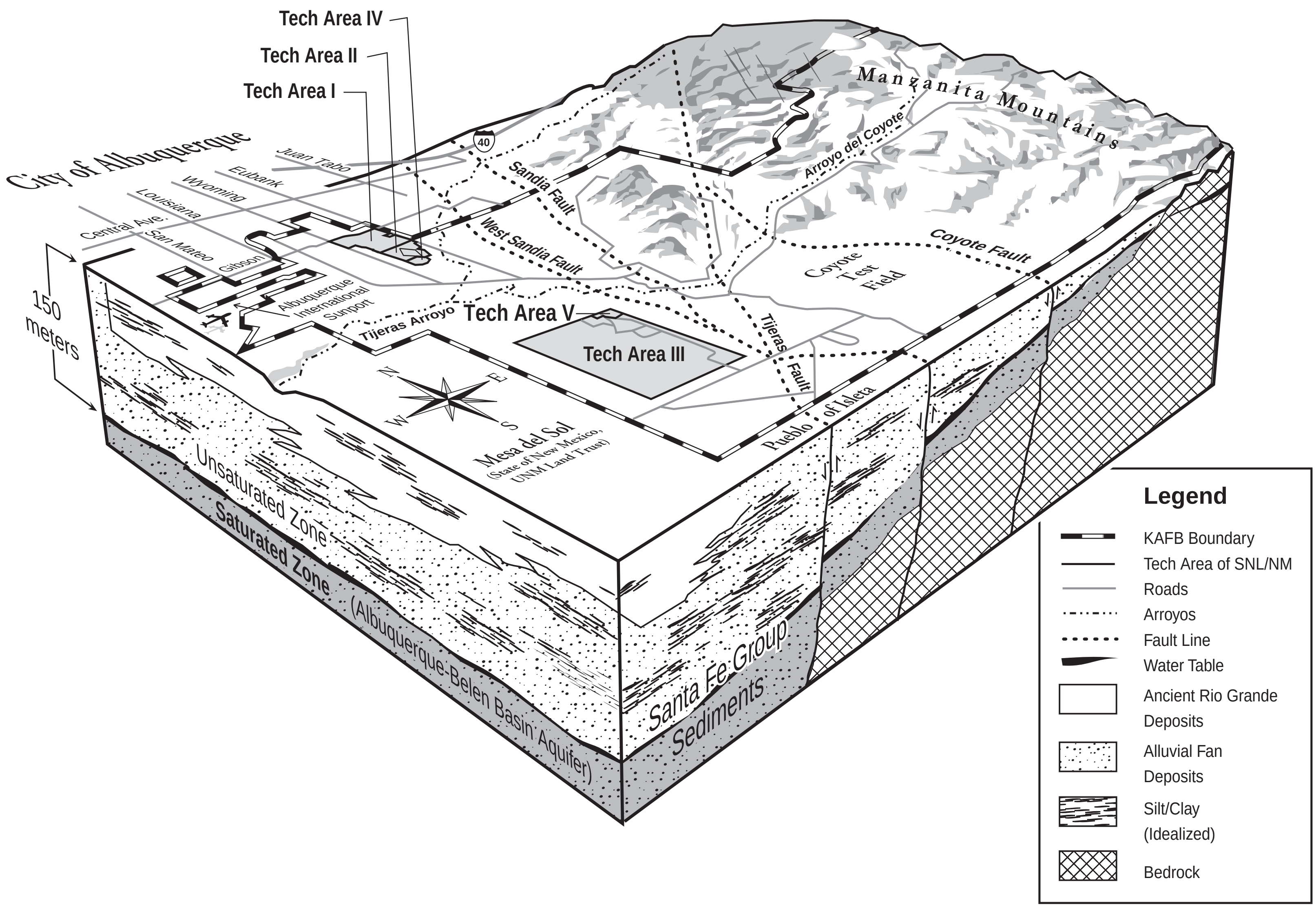
Floodplains on KAFB are generally confined to the major arroyos as shown in Figure 4–15. Although not shown in Figure 4–15, there are narrow 100-year floodplains that are confined to existing drainage channels and low-lying streets and vacant areas in TA-I. Otherwise, no SNL/NM facilities are built in a 100- or 500-year floodplain.

TA-V contains no permanent, natural surface water bodies and is not located within a delineated floodplain. A drainage ditch located on the northern border of the area conveys stormwater runoff to Arroyo del Coyote to the east.

4.3.6.2 Groundwater

Groundwater beneath the western portion of KAFB encompassing SNL/NM exists within an interconnected series of water-bearing geologic units, principally the Sante Fe Group, which comprise the Albuquerque-Belen Basin aquifer (**Figure 4–16**). This is the major source of groundwater within the Albuquerque Basin. Thus, the Albuquerque-Belen Basin aquifer (i.e., a valley-fill aquifer) is considered a Class II aquifer (i.e., currently used or potentially available for drinking water or other beneficial use) (DOE 1996f). The local hydrostratigraphy and associated water table elevations within the Albuquerque-Belen Basin aquifer beneath the western and central portions of KAFB are influenced by the Sandia/Tijeras/Hubbell Springs Fault system which transects KAFB, creating distinct hydrogeologic regions. As result, depth to the regional water table decreases appreciably to the east within blocks of downfaulted strata and ranges from approximately 150 meters (500 feet) near the western boundary of KAFB to about 45 meters (150 feet) near the Hubbell Springs Fault just southeast of TA-III. Shallow groundwater may be found near the surface in shallow alluvium along portions of Arroyo del Coyote northeast of TA-III. In contrast, groundwater beneath the far eastern portion of KAFB primarily occurs in limited quantities in the fractured bedrock, with the depth to groundwater thought to exceed 45 meters (150 feet). Groundwater flow is generally north to northwest in the northwestern portion of KAFB where TAs-I, -II, and -IV are located and generally to the west in the eastern portion of KAFB and within the central, faulted hydrogeologic region of KAFB (DOE 1996f). Locally, the direction of groundwater flows is to the northeast in the northern corner of KAFB towards the cone of depression created by base and city wells (SNL/NM 2001b). Perched groundwater bodies have also been identified at a depth of some 90 meters (300 feet) beneath TAs-I, -II, and -IV.

Sources of recharge to the basin, and to the Albuquerque-Belen Basin aquifer in particular, include precipitation runoff and snowmelt along the basin margins, underflow from interconnections with aquifers in adjacent basins, and surface recharge from irrigation and other artificial sources (DOE 1996f). Locally, recharge is in the form of infiltration of runoff through arroyos. However, the rate of groundwater withdrawal in the region, particularly by city of Albuquerque and KAFB supply wells, exceeds the relatively low recharge rate of 0.01 to 0.25 centimeters (0.004 to 0.1 inches) per year, a condition called overdraft. As a result, the regional water table just beneath the western portion of KAFB has been declining at a rate of 0.06 to 0.9 meters (0.2 to 3 feet) per year, while water levels farther to the east of the Sandia/Tijeras/Hubbell



Source: DOE 1999f.

Figure 4–16 Conceptual Diagram of Groundwater System Underlying KAFB

Springs Fault system have been much less affected. During the 12-year period from 1985 through 1996, water levels declined by more than 11 meters (35 feet) in the extreme northwestern portion of KAFB.

A network of monitoring wells is used to collect samples for characterizing baseline water chemistry and groundwater contamination, which is part of the site's environmental monitoring program. Groundwater quality at SNL/NM has been impacted by past activities at SNL/NM sites, with the sources of contamination under investigation. Sites with potential or known groundwater contamination at SNL/NM are Sandia North, which includes TA-I and TA-II; the Mixed Waste Landfill within the TA-III complex; locations in TA-V; the Lurance Canyon Burn Site, located in the eastern portion of KAFB; and the Chemical Waste Landfill, also within TA-III. The primary contamination at TA-V is trichloroethene which has been detected at levels of about three to four times the maximum contaminant level and attributed to the disposal of wastewater released to the Liquid Waste Disposal System site from 1963 to 1967. Sources of previously high levels of nitrate, including septic tanks and leachfields, have since been closed. Nitrate levels exceeding the maximum contaminant level have also been detected in groundwater at the Lurance Canyon Burn Site. Detailed information on groundwater monitoring including analytical results is presented in the annual site environmental report (SNL/NM 2001b).

The groundwater beneath SNL/NM and adjacent areas is the source of drinking water for SNL/NM, KAFB, and adjacent portions of the city of Albuquerque and the Pueblo of Isleta. The local groundwater is also used for irrigation and industry. Water use is detailed in Section 4.3.2.4.

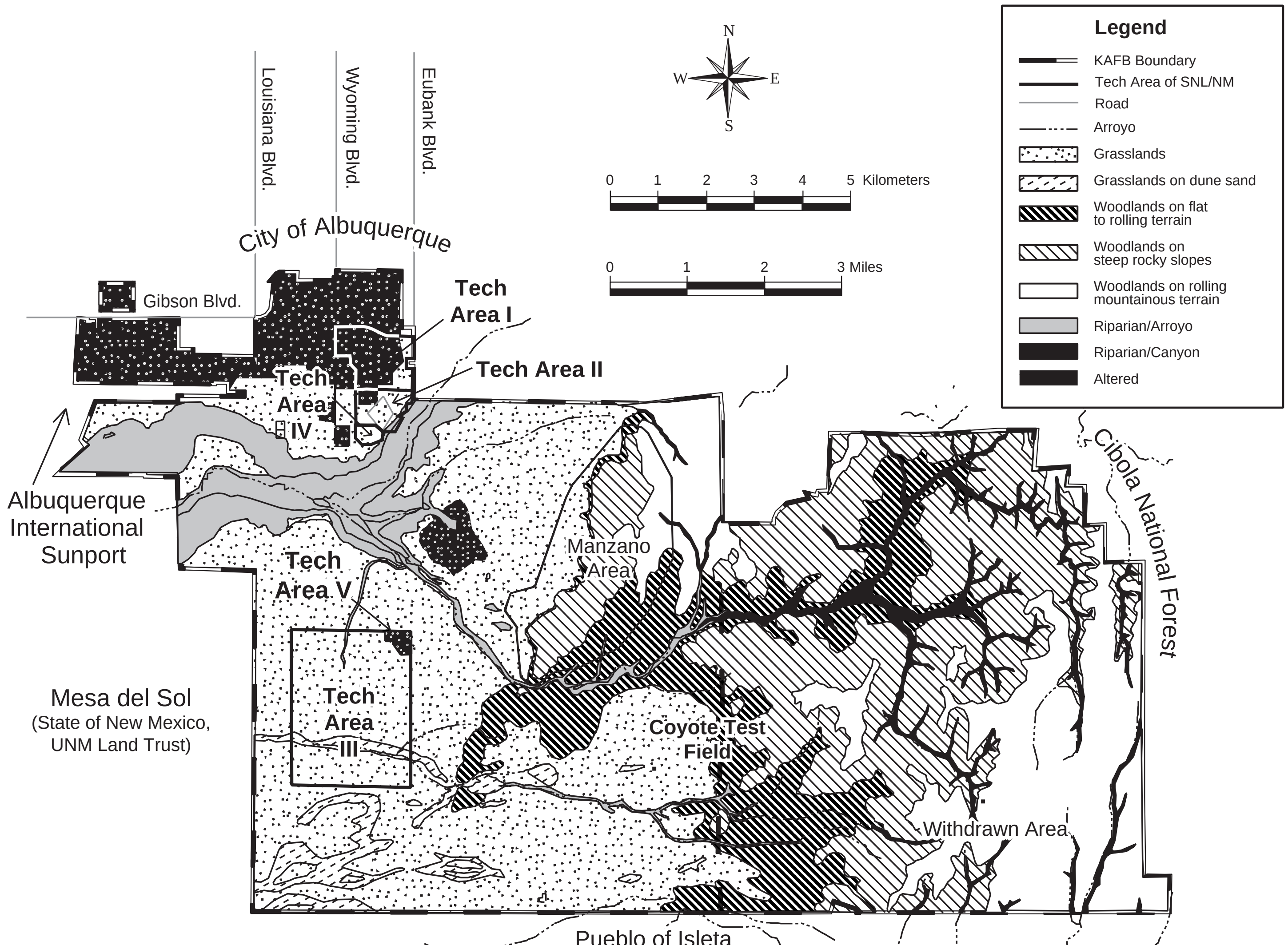
Groundwater beneath TA-V occurs within the Albuquerque-Belen Basin aquifer. The depth to groundwater is inferred as approximately 100 meters (330 feet) and the direction of flow is generally to the northwest. As previously discussed, trichloroethene and nitrate are contaminants present in the groundwater beneath TA-V. In FY99, trichlorethene was again detected in one monitoring well in excess of the EPA Maximum Contaminant Level of 10 micrograms per liter at a maximum concentration of 23 micrograms per liter. The only inorganic chemical detected in excess of applicable regulatory criteria was nitrate (Maximum Contaminant Level of 10 milligrams per liter) at a maximum concentration of 16.3 milligrams per liter (SNL/NM 2001b).

4.3.7 Ecological Resources

4.3.7.1 Terrestrial Resources

KAFB is located at the juncture of four major North American biological provinces: Great Basin, Rocky Mountains, Great Plains, and Chihuahuan Desert. Each province influences the existing biological communities. KAFB contains a diversity of biological resources due, in part, to these influences and an elevation change from a low point of approximately 1,585 meters (5,200 feet) in Tijeras Arroyo to a high point of 2,352 meters (7,715 feet) at Mount Washington in the Manzanita Mountains.

The four major vegetation associations at KAFB, grassland, woodland, riparian, and altered, are distinct in the form and composition of their vegetation (see **Figure 4–17**). The grassland association occupies the lower alluvial slopes and terrace surfaces of the Rio Grande valley near the city of Albuquerque. It is the dominant vegetation association on KAFB, west of the Withdrawn Area. Important species of this association include galleta, sand dropseed, ring muhly, black grama, and little bluestem (SNL/NM 1993). Woodland vegetation occurs primarily on the upper alluvial slopes and mountainous areas of the Withdrawn Area. Species present within woodland areas change with altitude. For example, one-seed juniper is present between 1,829 to 1,890 meters (6,000 to 6,200 feet), while an even mix of pinyon pine and one-seed juniper are found between 1,890 to 1,981 meters (6,200 to 6,500 feet). Many areas of the woodlands are becoming progressively choked with deadwood and dense thickets of young trees. Isolated, narrow bands of riparian



Source: Modified from DOE 1999f.

Figure 4–17 Vegetation Associations at KAFB

vegetation occur along the surface drainages of KAFB. These drainages are predominantly ephemeral and contain flow only after large rainfall events. Riparian vegetation constitutes less than 5 percent of the area of KAFB and is limited primarily to the upper reaches of Arroyo del Coyote and associated drainages. The riparian woodland vegetation is dominated by exotic species, principally salt-cedar, which is widespread in the arroyos on KAFB. Human development and activities have created altered vegetation associations at KAFB. This vegetation ranges from no vegetative cover to manicured landscapes, such as the golf course. Most of this vegetation consists of nonnative species. At least 267 plant species occur on KAFB.

At least 195 species of amphibians, reptiles, birds, and mammals occur on KAFB. This diversity is due, in part, to the variety of habitats, which include cliff faces, caves, abandoned mines, and drainages, in addition to the four major vegetation associations. Although an altered habitat, the grass, ponds, and variety of trees at the KAFB golf course provide a particularly rich haven for animals, including waterfowl and shorebirds. The most important ecological factor that controls wildlife communities on KAFB is the limited availability of surface water. Common animals on KAFB include the whiptail lizard, red-spotted toad, American kestrel, ash-throated flycatcher, coyote, and deer mouse. Game animals which occur on the site, primarily within woodland and canyon habitats, include the mountain lion, black bear, and mule deer; however, hunting is not permitted on site. Raptors, such as the American kestrel and Cooper's hawk, and carnivores, such as the coyote and mountain lion, are two ecologically important groups on the KAFB. A variety of migrating birds have been recorded at the site. Migratory birds are protected under the Migratory Bird Treaty Act.

TA-V is located within the grassland vegetative association; however, the site has been altered by development and little natural habitat is present. Grasses present within undeveloped portions of the area would include those typical of the grassland association on the site as a whole. Animal species common to the grassland vegetative association, such as the coyote and red-tailed hawk, would be expected to be found in the general vicinity of TA-V.

4.3.7.2 Wetlands

Natural spring-fed wetlands form a minor component of the riparian habitat on KAFB and are cumulatively less than 0.4 hectares (1 acre) in size. KAFB has six wetlands, all associated with springs (see Figure 4–15). These wetlands are designated as jurisdictional wetlands under Section 4.04 of the Clean Water Act, because they have the soils, hydrology, and vegetation that meet standard criteria. The largest wetland is Coyote Springs in Arroyo del Coyote. Two of the wetlands, Sol se Mete and Burn Site Springs, are in the canyons of the Withdrawn Area. Species characteristic of these wetlands include wire rush, three-square, Torrey rush, and cattail. Only the Burn Site Spring is on land used by SNL/NM. The U.S. Forest Service manages a tank that collects water for wildlife at this spring and the Sol se Mete Spring. There are no wetlands located within TA-V.

4.3.7.3 Aquatic Resources

There is no permanent natural aquatic habitat on KAFB. Drainages found on the site are predominantly ephemeral and contain flow only after large rainfall events. The U.S. Air Force administers constructed ponds on the KAFB golf course and a constructed lake, Christian Lake, in the southern part of KAFB. There are no aquatic resources located within TA-V.

4.3.7.4 Threatened and Endangered Species

There are four agencies that have authority to designate threatened, endangered, and sensitive species in New Mexico. The agencies are the USFWS, the New Mexico Game and Fish Department, the New Mexico Forestry and Resource Conservation Division, and the U.S. Forest Service. The State of New Mexico separates the regulatory authority for plants and animals between the Forestry and Resource Conservation Division and the Game and Fish Department, respectively. The U.S. Forest Service lists species for special management consideration on lands under their jurisdiction and protects these species under the authority of the Endangered Species Act of 1973.

Table 4–24 lists the threatened, endangered, and sensitive plant species on KAFB. One state-listed sensitive plant species, the Santa Fe milkvetch, occurs on the low hills in the southwestern part of KAFB. The Strong prickly pear, found near the northern boundary of KAFB, is on the State of New Mexico Rare Plant Review List.

Table 4–24 Listed Threatened and Endangered Species, Species of Concern, and Other Unique Species that Occur or May Occur at SNL/NM

Species	*Federal Classification*	*State Classification*	*Occurrence on Sandia*
Mammals			
Gunnison's prairie dog	Unlisted	Special Concern	Resident
Pale Townsend's big-eared bat	Special Concern	Special Concern	Occasional
Small-footed myotis	Special Concern	Special Concern	Occasional
Western spotted skunk	Unlisted	Special Concern	Low probability of occurrence
Birds			
American peregrine falcon	Special Concern	Threatened	Not documented
Baird's sparrow	Special Concern	Threatened	Winter visitor
Bell's vireo	Special Concern	Threatened	Winter visitor
Black swift	Unlisted	Special Concern	Occasional in summer and as a migrant
Ferruginous hawk	Special Concern	Special Concern	Transient
Gray vireo	Special Concern	Threatened	Occasional
Loggerhead strike	Special Concern	Special Concern	Resident
Mountain plover	Endangered	Special Concern	Not documented
Swainson's hawk	Special Concern	Special Concern	Occasional
Western burrowing owl	Special Concern	Special Concern	Occasional
White-faced ibis	Special Concern	Special Concern	Casual
Reptiles			
Desert massasuaga	Special Concern	Unlisted	Low probability of occurrence
Texas horned lizard	Special Concern	Special Concern	Resident
Texas longnose snake	Special Concern	Special Concern	Moderate probability of occurrence
Plants			
Grama grass cactus	Special Concern	Unlisted	Resident
Sante Fe milkvetch	Special Concern	NML2	Resident
Strong prickly pear	Unlisted	NML3	Not documented

NML2 = New Mexico List 2: Official listing of plant species that are vulnerable to extinction or extirpation within the state due to rarity or restricted distribution, but are not protected under the New Mexico Endangered Plant Species Act.

NML3 = New Mexico List 3: Official listing of plant species that are on the New Mexico Rare Plant Review List as species for which more information is needed, but are not protected under the New Mexico Endangered Plant Species Act.

Source: DOE 1999f.

The peregrine falcon was the only federally listed threatened or endangered animal species that may frequent KAFB. A probable sighting near Mount Washington was likely a migrant. No nesting activity of this species has been observed, and KAFB contains only marginal nesting habitat. In 1997, the U.S. Air Force conducted a raptor survey of KAFB and did not observe any listed raptor species. On August 25, 1999, the USFWS delisted the American peregrine falcon from the Federal list of endangered and threatened wildlife. The USFWS has determined that this species has recovered following restrictions on the use of organochlorine pesticides (such as dichloro-diphenyl-trichloroethane) in the United States and Canada, following the implementation of successful management activities (64 FR 46541). On February 16, 1999, the USFWS designated the mountain plover as a proposed threatened species. Although KAFB could contain potential habitat for the mountain plover, numerous avian surveys of the Withdrawn Area and KAFB in general have not documented its presence. No federally proposed or candidate species occur on KAFB. In 1993, a colony of state-listed threatened gray vireos was discovered in the western foothills of the Withdrawn Area on land controlled by the U.S. Air Force. This is the largest known concentration of gray vireos in the State of New Mexico. Eight species of concern have been observed on KAFB, in addition to 13 migratory nongame birds of management concern for the USFWS Region 2. These species are protected under the Migratory Bird Treaty Act. Four state-listed threatened animal species occur on KAFB. One state-listed sensitive species, Pale Towsend's big-eared bat, has been observed hibernating in two caves. No critical habitat for threatened or endangered species has been identified on KAFB.

No federally listed threatened and endangered species utilize TA-V. However, since TA-V is located in the grassland plant association sensitive species could frequent the area. No designated critical habitat is present on TA-V.

4.3.8 Cultural and Paleontological Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulation, and guidelines. A draft *Cultural Resource Management Plan for Kirtland Air Force Base New Mexico* addressing resources across the entire base is summarized in the *SNL/NM SWEIS*. Due to the paucity of identified cultural resources under DOE jurisdiction, DOE has not prepared a cultural resource management plan. Since the first documented survey in 1936, both KAFB and the DOE buffer zones (land bordering the site to the southwest) have been the subject of cultural resource studies. Over 160 cultural resource investigations, reports, and studies have been conducted, most in the last 10 years. Approximately 75 percent of the area has been studied. Within the boundaries of KAFB and the DOE buffer zone, 284 prehistoric and historic archaeological sites have been recorded, of which 192 have been recommended as eligible or potentially eligible for the National Register of Historic Places.

Cultural sites are often occupied continuously or intermittently over substantial time spans. For this reason, a single location may contain evidence of use during both historic and prehistoric periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented. However, the sum of these resources may be greater than the total number of sites reported due to this dual-use history at sites. Therefore, where the total number of sites reported is less than the sum of prehistoric and historic sites, certain locations were used during both periods.

4.3.8.1 Prehistoric Resources

Predominant among the prehistoric sites on KAFB are scatters of artifacts. Some artifact scatters consist of only stone debris from tool making and some tools themselves, while others have only ceramic shards or have both stone and ceramic artifacts. Some sites have just the artifact scatter, while others have features associated with the scatter. These features are often thermal features (such as hearths or ash pits) or structural features (such as remnants of walls or other forms of structures). A total of 181 sites have evidence of prehistoric use, of which 141 are eligible or potentially eligible for listing on the National Register of Historic Places. Because not all of the sites have been inventoried and buried sites would likely not have been identified during many past surveys, the potential for the presence of more sites is high. TA-V has been completely inventoried for prehistoric sites and no sites have been identified.

4.3.8.2 Historic Resources

As with prehistoric sites, historic sites on KAFB consist of artifact scatters, except that the artifacts present are things such as fragments of metal, pieces of ceramic or porcelain dishes, household items such as kitchen utensils, and other items one might find associated with a habitation. These scatters are often associated with features such as historic fences, roads, mining features (e.g., placer mining pits), or remnants of habitations. Of the historic sites, mining sites are the most common, followed by habitations, then sites related to agriculture and ranching, then small, isolated trash scatters. A total of 153 sites have evidence of historic use, of which 88 are eligible or potentially eligible for listing on the National Register of Historic Places.

Within KAFB, 579 architectural properties have been recorded and assessed for National Register of Historic Places eligibility, of which 9 individual properties have been recommended as eligible or potentially eligible for the National Register of Historic Places. Most sites were recorded by the 377th Air Base Wing of KAFB, under the auspices of the U.S. Department of Defense Legacy Program, and are on KAFB lands. Few of these properties predate World War II, and most were constructed during the 1940s and 1950s. Recent studies identified 21 buildings in TA-I that are of historic interest, and further study by DOE, in consultation with the New Mexico State Historic Preservation Office, will determine if these buildings are eligible for the National Register (SNL/NM 2001b). The architectural properties in TA-II, as a group, are eligible for National Register of Historic Places listing as a district.

TA-V has been completely inventoried for historic sites and no sites have been identified. Assessments of buildings in TA-V for inclusion in the National Register of Historic Places have not been made since structures located there are less than 50 years old. As the buildings at the site attain the 50-year mark, DOE will assess them for eligibility for inclusion in the National Register.

4.3.8.3 Native American Resources

Consultations to identify traditional cultural properties were conducted in connection with the preparation of the *SNL/NM SWEIS*. A traditional cultural property is a place or object that is significant to a particular living community. Fifteen Native American tribes with cultural interest in the area were contacted and no specific traditional cultural property locations were identified. However, some tribes have stated that they have cultural affinity to archaeological and natural sites on KAFB and expressed concerns for cultural sites that are important to them. Areas of concern to some of the tribes included the well-being and protection of natural and cultural sites; access to any traditional cultural properties identified in the future; concerns for the treatment of human remains that might be discovered; a desire to be consulted on Native American Graves Protection and Repatriation Act issues; claims of traditional use of the area before restricted access became effective; and use of the area for hunting and gathering of resources.

As noted above, TA-V has been completely inventoried for prehistoric sites and historic sites and no such sites have been identified. No traditional cultural properties have been identified on KAFB, including TA-V.

4.3.8.4 Paleontological Resources

Few paleontological resources have been discovered in the vicinity of KAFB, although fossil vertebrate remains have been found approximately 5 to 6 kilometers (3.1 to 3.7 miles) northwest of TA-V. These include an anklebone from a camel, a skull and teeth from a horse, and teeth from a hare. These fossils were excavated on the south side of Tijeras Arroyo and may have been transported varying distances from their original source. It is possible that fossils are present on KAFB, but are buried by the alluvial fan deposits from the Sandia Mountains (SNL/NM 1993). No fossils have been identified at TA-V.

4.3.9 Socioeconomics

Statistics for population, housing, community services, and local transportation are presented for the region of influence, a four-county area in New Mexico (**Figure 4–18**) that includes the city of Albuquerque, which is where approximately 97.5 percent of all SNL/NM employees reside (see **Table 4–25**). In 1997, SNL/NM employed 6,824 persons.

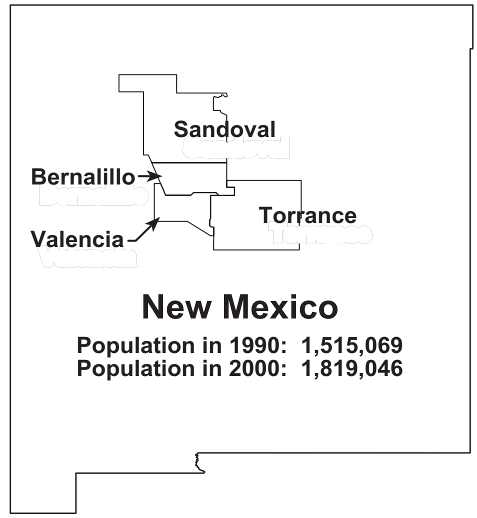


Figure 4–18 Counties in the SNL/NM Region of Influence

4.3.9.1 Regional Economic Characteristics

Between 1990 and 1999, the civilian labor force in the region of influence increased 18.8 percent to the 1999 level of 360,924. In 1999, the annual unemployment average in the region of influence was 4.0 percent, which was slightly less than the annual unemployment average for New Mexico (5.6 percent) (DOL 2000).

In 1997, service activities represented the largest sector of employment in the four-county area (33.3 percent). This was followed by retail trade (24.4 percent), and government (19.4 percent). The totals for these employment sectors in New Mexico were 27.5 percent, 23.7 percent, and 25.1 percent, respectively (NMDL 1998). SNL/NM is the fifth largest employer in New Mexico and the third largest in the four-county area.

Table 4–25 Distribution of Employees by Place of Residence in the SNL/NM Region of Influence in 1997

County	*Number of Employees*	*Total Site Employment (percent)*
Bernalillo	5,846	85.7
Sandoval	311	4.6
Torrance	160	2.3
Valencia	336	4.9
Region of influence total	6,653	97.5

Source: DOE 1999f.

4.3.9.2 Demographic Characteristics

The 2000 demographic profile of the region of influence population is included in **Table 4–26**. The 2000 population in the region of influence was 729,649 people, of whom about 76 percent lived in Bernalillo County. Persons self-designated as minority individuals comprise 52 percent of the total population. This minority population is composed largely of Hispanic or Latino and American Indian residents. The Pueblos of Cochiti, Isleta, Jemez, San Felipe, Sandia, Santa Ana, Santo Domingo, and Zia, and the Canoncito Navajo Reservation are important centers of these American Indian populations.

Income information for the SNL/NM region of influence is included in **Table 4–27**. Bernalillo, Sandoval, and Valencia Counties each had median household incomes near or above the New Mexico state average ($30,836). The median household income for Torrance County ($26,334) was below the state average. Torrance County had 24.6 percent of the population living below the poverty line compared to the New Mexico state average of 19.3 percent.

Table 4–26 Demographic Profile of the Population in the SNL/NM Region of Influence

	County				*Region of Influence*
	Bernalillo	*Sandoval*	*Torrance*	*Valencia*	
Population					
2000 population	556,678	89,908	16,911	66,152	729,649
1990 population	480,577	63,319	10,285	45,235	599,416
Percent change from 1990 to 2000	15.8	42.0	64.4	46.2	21.7
Race (2000) (Percent of Total Population)					
White	70.8	65.1	73.9	66.5	69.7
Black or African American	2.8	1.7	1.7	1.3	2.5
American Indian and Alaska Native	4.2	16.3	2.1	3.3	5.5
Asian	1.9	1.0	0.3	0.4	1.6
Native Hawaiian & Other Pacific Islander	0.1	0.1	0.1	0.1	0.1
Some other race	16.1	12.4	17.9	23.9	16.4
Two or more races	4.2	3.5	4.0	4.6	4.1
Percent Minority	51.7	49.7	42.8	60.6	52.0
Ethnicity (2000)					
Hispanic or Latino	233,565	26,437	6,283	36,371	302,656
Percent of total population	42.0	29.4	37.2	55.0	41.5

Source: DOC 2001.

Table 4–27 Income Information for the SNL/NM Region of Influence

	Bernalillo	*Sandoval*	*Torrance*	*Valencia*	*New Mexico*
Median household income 1997 ($)	36,853	40,139	26,334	30,092	30,836
Percent of persons below poverty line (1997)	14.6	12.9	24.6	18.3	19.3

Source: DOC 2000.

4.3.9.3 Housing and Community Services

Table 4–28 lists the total number of occupied housing units and vacancy rates in the region of influence. In 1990, the four-county area contained 246,561 housing units, of which 225,289 were occupied. The median value of owner-occupied units was $85,300 in Bernalillo County, which is higher than the other three counties and nearly twice the median value of units in Torrance County. Coincidentally, the vacancy rate was lowest in Bernalillo County (7.8 percent) and highest in Torrance County (24.8 percent).

Community services include public education and healthcare (i.e., hospitals, hospital beds, and doctors). In 1998, student enrollment in the region of influence totaled 120,159 and the average student-to-teacher ratio was 16.4:1 (Department of Education 2000). Community health services and facilities are concentrated in Bernalillo County.

Table 4–28 Housing and Community Services in the SNL/NM Region of Influence

	County				
	Bernalillo	***Sandoval***	***Torrance***	***Valencia***	***Region of Influence***
Housing (1990) [a]					
Total units	201,235	23,667	4,878	16,781	246,561
Occupied housing units	185,582	20,867	3,670	15,170	225,289
Vacant units	15,653	2,800	1,208	1,611	21,272
Vacancy rate (percent)	7.8	11.8	24.8	9.6	8.6
Median value ($)	85,300	69,600	46,500	72,100	Not available
Public Education (1998) [b]					
Total enrollment	85,847	14,700	6,171	13,441	120,159
Student-to-teacher ratio	16.3:1	16.4:1	17.2:1	17.1:1	16.4:1
Community Healthcare (1998) [c]					
Hospitals	8	0	0	0	8
Hospital beds per 1,000 persons	3.1	0	0	0	2.3
Physicians per 1,000 persons	3.7	0.9	0.3	0.5	3

[a] DOE 1999f.
[b] Department of Education 2000.
[c] Gaquin and DeBrandt 2000.

4.3.9.4 Local Transportation

Key roads in the vicinity of KAFB include Interstates 25 and 40 (see Figure 4–12). Interstate 25 runs north-south and is approximately 1.5 miles west of the KAFB boundary at its nearest approach. Interstate 40 runs east-west through Albuquerque and is approximately 1.6 kilometers (1 mile) north of the KAFB boundary at its nearest approach. Access to KAFB and SNL/NM consists of an urban road network maintained by the city of Albuquerque, the gates and roadways of KAFB, and SNL/NM-maintained roads. Traffic enters SNL/NM through three principal gates: Wyoming, Gibson, and Eubank. Most commercial traffic enters through the Eubank gate because it provides direct access to the SNL/NM shipping and receiving facilities located in TA-II. An additional entrance to KAFB, the Truman gate, serves KAFB's western areas. The roads near SNL/NM experience heavy traffic in the early morning and late afternoon. The principal contributors are SNL/NM staff and other civilian and military personnel commuting to and from KAFB.

The Burlington Northern & Santa Fe Railroad discontinued its spur into KAFB in 1994. Land within KAFB, permitted to DOE for the railroad right-of-way, has been returned to the U.S. Air Force and demolition of the spur has begun. Primary air service is provided for the entire region by the Albuquerque International Sunport, located immediately northwest of KAFB. Runways and other flight facilities are shared with KAFB.

4.3.10 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. As discussed in Appendix E, minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multiracial. Persons whose income is below the Federal poverty threshold are designated as low-income.

TA-V is located at latitude 34° 59' 46.13" north, longitude 106° 31' 49.85" west. **Figure 4–19** shows the location of TA-V and the region of potential radiological impacts. As shown in the figure, the region surrounding TA-V includes the Albuquerque Metropolitan Area and Indian Reservations in the Albuquerque-Santa Fe areas.

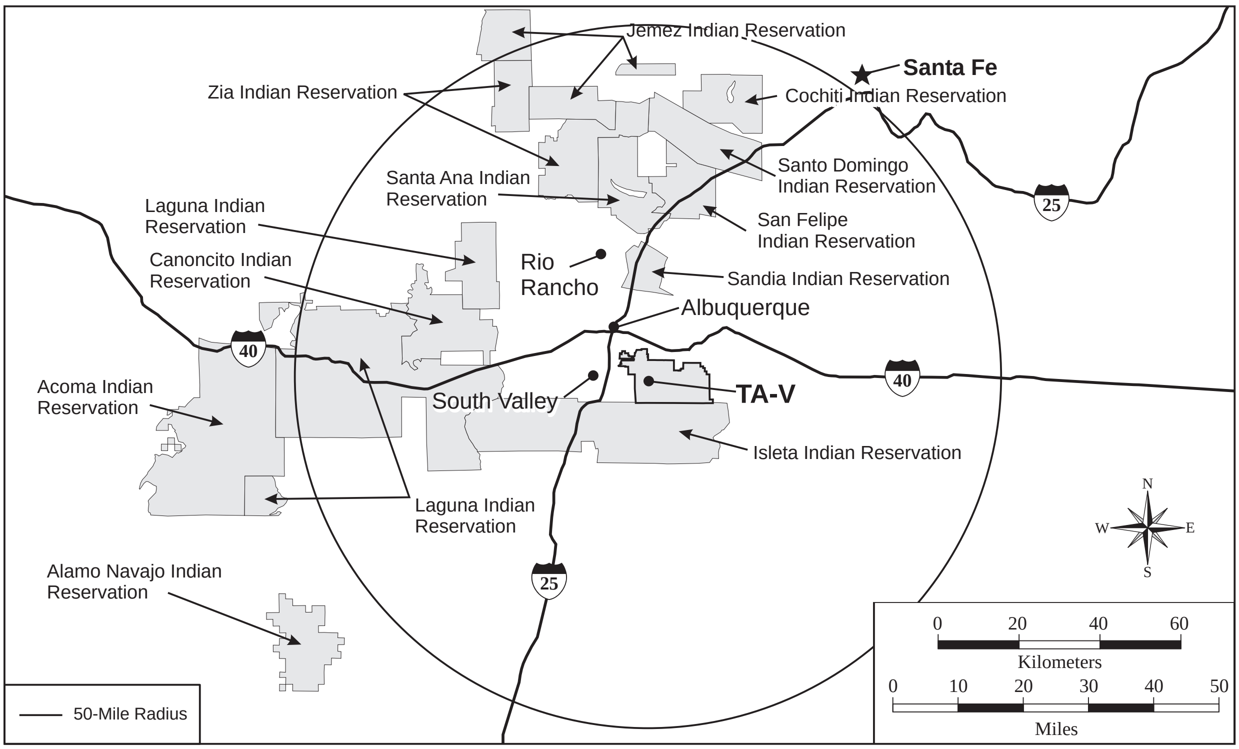


Figure 4–19 Location of TA-V and Indian Reservations Surrounding SNL/NM

Nine counties are included or partially included in the potentially affected area (see **Figure 4–20**): Bernallilo, Cibila, McKinley, Sandoval, San Miguel, Santa Fe, Socorro, Torrance, and Valencia. **Table 4–29** provides the racial and Hispanic composition for these counties using data obtained from the decennial census conducted in 2000. In the year 2000, a majority of these county residents designated themselves as members of a minority. Hispanics and American Indians/Alaska Natives comprised over 90 percent of the minority population. As a percentage of the total resident population in 2000, New Mexico had the largest percentage minority population (55 percent) among the contiguous states and the second largest percentage minority population among all of the states—only Hawaii had a larger percentage minority population (77 percent).

Figure 4–21 compares the growth in the minority populations in potentially affected counties between 1990 and 2000. As discussed in Section E.5.1 of Appendix E, data concerning race and Hispanic origin from the 2000 Census cannot be directly compared with that for the 1990 Census because the racial categories used in the two enumerations were different. Bearing this change in mind, the minority population in potentially affected counties increased from approximately 51 percent to 57 percent in the decade from 1990 to 2000. Hispanics and American Indians/Alaska Natives accounted for approximately 84 percent of the increase in minority population during the decade. For comparison, minorities composed approximately one-quarter of the total population of the United States in 1990 and nearly one-third of the total population in 2000.

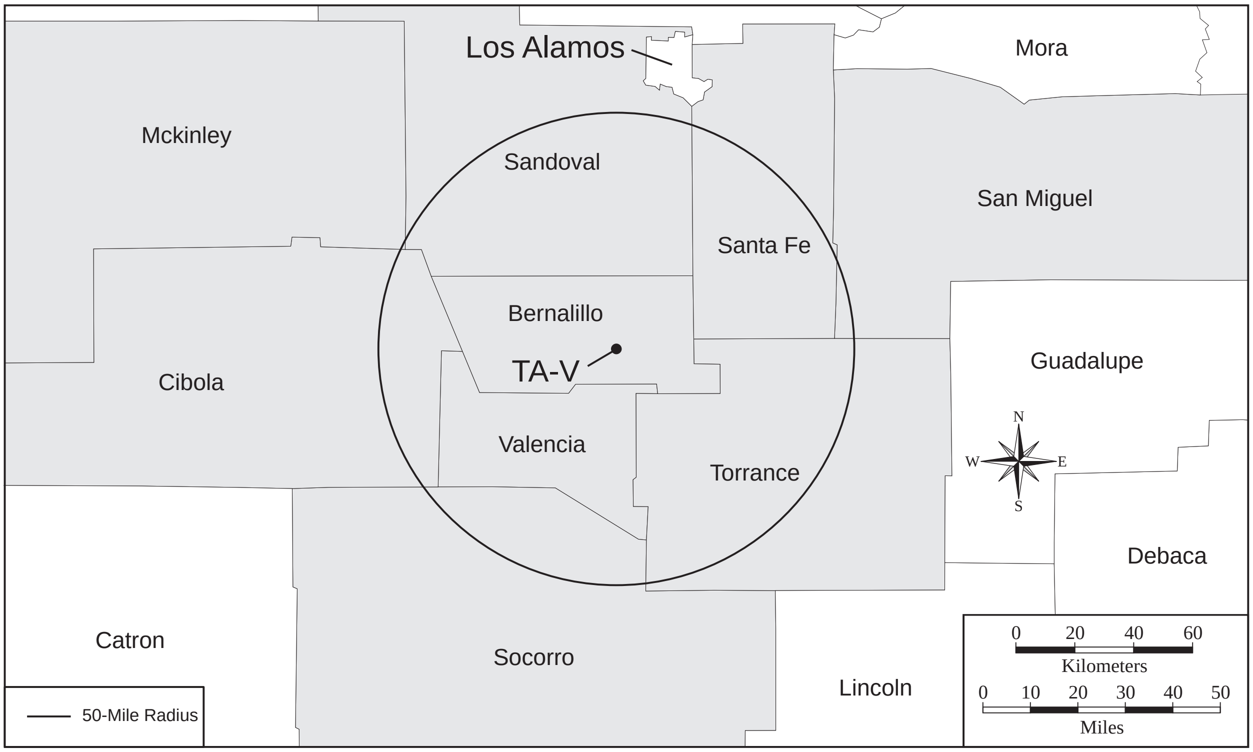


Figure 4–20 Potentially Affected Counties Surrounding TA-V at SNL/NM

Table 4–29 Populations in Potentially Affected Counties Surrounding TA-V in 2000

Population Group	Population	Percentage of Total
Minority	569,428	56.5
Hispanic	416,189	41.3
Black/African American	17,533	1.7
American Indian/Alaska Native	106,093	10.5
Asian	13,213	1.3
Native Hawaiian/Pacific Islander	647	0.1
Two or More Races	15,753	1.6
Some Other Race	1,644	0.2
White	436,466	43.3
Total	1,007,538	100.0

Source: DOC 2001.

The percentage of low-income population at risk in potentially affected counties surrounding TA-V in 1990 was approximately 15 percent. In 1990, nearly 13 percent of the total population of the continental United States reported incomes less than the poverty threshold. In terms of percentages, minority populations at risk are relatively large in comparison with the national percentage, while the percentage low-income population at risk is commensurate with the corresponding national percentage. Complete census data with block group resolution for minority and low-income populations obtained from the decennial census of 2000 are scheduled for publication in 2002.

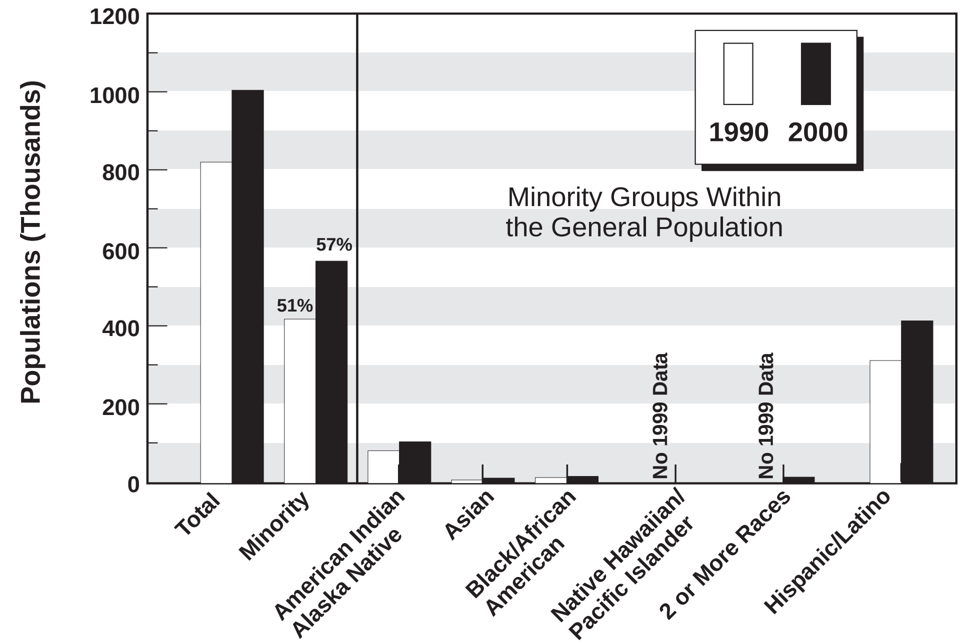


Figure 4–21 Comparison of Populations in Potentially Affected Counties Surrounding TA-V in 1990 and 2000

4.3.11 Existing Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health that result from acute and chronic exposures to ionizing radiation and hazardous chemicals.

4.3.11.1 Radiation Exposure and Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of SNL/NM are shown in **Table 4–30**. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to SNL/NM operations.

Releases of radionuclides to the environment from SNL/NM operations provide another source of radiation exposure to individuals near the site. Types and quantities of radionuclides released from SNL/NM operations in 1999 are listed in the *1999 Annual Site Environmental Report, Sandia National Laboratories, Albuquerque, New Mexico* (SNL/NM 2001b). The releases are summarized in Section 4.3.3.2 of this EIS. The doses to the public resulting from these releases are presented in **Table 4–31.** These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those of background radiation.

Table 4–30 Sources of Radiation Exposure to Individuals in the SNL/NM Vicinity Unrelated to SNL/NM Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural Background Radiation	
Total external (cosmic and terrestrial) [a]	92
Internal terrestrial and global cosmogenic [b]	40
Radon in homes (inhaled)	200 [b, c]
Other Background Radiation [b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	less than 1
Air travel	1
Consumer and industrial products	10
Total	397

[a] SNL/NM 1999a, SNL/NM 2001b.
[b] NCRP 1987.
[c] An average for the United States.

Table 4–31 Radiation Doses to the Offsite Public from Normal SNL/NM Operations in 1999 (total effective dose equivalent)

Members of the Public	*Atmospheric Releases*		*Liquid Releases*		*Total*	
	Standard [a]	*Actual*	*Standard* [a]	*Actual*	*Standard* [a]	*Actual*
Maximally exposed offsite individual (millirem)	10	0.00021	4	0	100	0.00021
Population within 80 kilometers (50 miles) (person-rem) [b]	None	0.0221	None	0	100	0.0221
Average individual within 80 kilometers (50 miles) (millirem) [c]	None	3.2×10^{-5}	None	0	None	3.2×10^{-5}

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10-millirem-per-year limit from airborne emissions is required by the Clean Air Act (40 CFR 61) and the 4-millirem-per-year limit is required by the Safe Drinking Water Act (40 CFR 141). The total dose of 100 millirem per year is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, *Radiation Protection of the Public and Environment: Proposed Rule*, as published in 58 FR 16268. If the potential total dose exceeds the 100-person-rem value, the contractor operating the facility is required to notify DOE.
[b] Based on an estimated population of 695,400 in 1999.
[c] Obtained by dividing the population dose by the number of people living within 80 kilometers (50 miles) of the site.
Source: SNL/NM 2001b.

Using a risk estimator of 1 latent cancer death per 2,000 person-rem to the public (see Appendix B), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from SNL/NM operations in 1999 is estimated to be 1.1×10^{-10}. That is, the estimated probability of this hypothetical person dying of cancer at some point in the future from radiation exposure associated with one year of SNL/NM operations is about 1 in 10 billion (it takes several to many years from the time of radiation exposure for a cancer to manifest itself).

According to the same risk estimator, 1.1×10^{-5} excess fatal cancers are projected in the population living within 80 kilometers (50 miles) of SNL/NM from normal operations in 1999. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 1999 from all causes in the population living within 80 kilometers (50 miles) of SNL/NM was 1,390. This expected number of fatal cancers is much higher than the 1.1×10^{-5} fatal cancers estimated from SNL/NM operations in 1999.

Members of the public living on site at KAFB receive the same dose as the offsite public from background radiation, but they also receive an additional dose from SNL/NM facilities with nuclear materials. The maximum exposed individual on site would be a hypothetical member of the public (onsite public housing resident) located near the Kirtland Underground Munitions Storage Complex. The maximum dose to the onsite person and the cumulative dose to all onsite residents from operations in 1999 are presented in **Table 4–32.** According to a risk estimator of one latent fatal cancer per 2,000 person-rem (see Appendix B), the number of projected fatal cancers among onsite residents from normal operations in 1999 is 2.6×10^{-7}.

Table 4–32 Radiation Doses to the Onsite Public in 1999 and to Workers in 1998 Due to Normal SNL/NM Operations (total effective dose equivalent)

Onsite Receptor	*Onsite Releases and Direct Radiation*	
	Standard	*Actual*
Maximally exposed onsite public receptor (millirem per year)	Refer to Table 4-31	8.5×10^{-4}
Collective KAFB resident population (person-rem per year) [a]	None	5.1×10^{-4}
Average badged worker (millirem per year) [b]	None [c]	52
Collective badged worker population (person-rem per year) [b]	None	9.5

[a] Based on a population of 5,670 people estimated to be living in permanent on-base housing.
[b] Based on a badged worker population of 181 receiving a measured total effective dose equivalent over 10 millirem.
[c] No standard is specified for an average radiation worker; however, the radiological limit for an individual worker is 5,000 millirem per year (10 CFR 835). DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 millirem per year (DOE 1999e); the site must make reasonable attempts to maintain individual worker doses as low as reasonably achievable below this level.
Sources: DOE 1998c, SNL/NM 2001b.

The average dose to a badged worker and the collective dose to the badged worker population, both of whom have a measured total effective dose equivalent greater than 10 millirems, are also shown in Table 4–32. The risk estimator for workers is one latent fatal cancer per 2,500 person-rem. The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups. Based on the risk estimator for workers, the number of projected fatal cancers in the badged worker population of 181 from normal operations in 1998 is 0.0038.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *1999 Annual Site Environmental Report, Sandia National Laboratories, Albuquerque, New Mexico* (SNL/NM 2001b). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (on and off the site) also are presented.

External radiation doses have been measured on the SNL/NM site that may contain radiological sources for comparison with offsite natural background radiation levels. Measurements taken in 1999 showed an average onsite dose on the SNL/NM site of 109 millirem compared to an offsite dose of 99 millirem (SNL/NM 2001b).

External concentrations of gross alpha and beta radiation in air are measured at SNL/NM. The concentrations in air of gross alpha and beta radiation in the general vicinity of TA-V in 1999 were 3.9×10^{-15} curies per cubic meter and 1.12×10^{-14} curies per cubic meter, respectively. These concentrations were about the same as measured at other onsite locations (SNL/NM 2001b).

4.3.11.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at SNL/NM via inhalation of air containing hazardous chemicals released to the atmosphere by SNL/NM operations. Risks to public health from ingestion of contaminated drinking water or direct exposure to hazardous chemicals are also potential pathways.

Baseline air emission concentrations for air pollutants and their applicable standards are presented in Section 4.3.3.1. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are compared with applicable guidelines and regulations.

Chemical exposure pathways to SNL/NM workers during normal operation may include inhaling the workplace atmosphere, drinking SNL/NM potable water, and other possible contacts with hazardous materials associated with work assignments. Workers are protected from hazardous materials specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. SNL/NM workers are also protected by adherence to OSHA and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation process, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at SNL/NM are substantially better than are required by standards.

4.3.11.3 Health Effects Studies

There are no known epidemiological studies that examine the impact of SNL/NM on the health of the surrounding communities. The Office of Epidemiologic Studies Epidemiologic Surveillance Program has been implemented at SNL/NM to monitor the health of current workers at the Albuquerque site. This program monitors and evaluates the occurrence of illness and injury in the workforce on a continuing basis and issues annual reports. Epidemiologic surveillance makes use of routinely collected health data including reasons for illness absence, disabilities, and the OSHA recordable injuries and illnesses. These health event data, coupled with demographic data about the active workforce, are analyzed to evaluate whether particular occupational groups are at increased risk of disease or injury when compared with other workers at SNL/NM. A summary of epidemiological surveillance at SNL/NM can be found in Volume II, Appendix E, Section E.4.8 of the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996f).

4.3.11.4 Accident History

A review of the SNL/NM annual environmental and accidental reports indicates that there have been no significant adverse impacts to workers, the public, or the environment. This review was performed to examine the site's accident history. The period of review, from 1986 to 1990, was a time during which plant operations were much higher than in previous years and the years following the review period (DOE 1996f).

4.3.11.5 Emergency Preparedness

Each DOE site has an established emergency management program that would be activated in the event of an accident. This program has been developed and is maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with planning, preparedness, and response (DOE 1996f). In addition, DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at Hanford in May 1997.

4.3.12 Waste Management

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies, and in compliance with all applicable Federal and state statutes and DOE orders.

4.3.12.1 Waste Inventories and Activities

SNL/NM manages the following types of waste: transuranic, mixed transuranic, low-level radioactive, mixed low-level radioactive, hazardous, and nonhazardous. Because there is no transuranic or mixed transuranic waste associated with TA-18 operations, these waste types are not discussed in this EIS. Waste generation rates and the inventory of stored waste from activities at SNL/NM are provided in **Table 4–33**. The SNL/NM waste management capabilities are summarized in **Table 4–34**.

Although not listed on the National Priorities List, SNL/NM adheres to the CERCLA guidelines for environmental restoration projects that involve certain hazardous substances not covered under RCRA. The initial remedial assessment of SNL/NM potential release sites was conducted under CERCLA beginning in 1984 and ending in 1987. The assessment identified 117 potential release sites. By 1993, the number had increased to 219 potential release sites, including offsite locations. Remediation field activities conducted under the Environmental Restoration Project are scheduled for completion in FY02, with permit modification by FY04 to remove remediated release sites from further action. As of August 1998, 60 release sites remained on the list for restoration or additional assessment. SNL/NM has proposed to the appropriate regulatory authority no further action for 122 of the 182 release sites. There are 11 environmental restoration sites within TA-V. Only two of these sites are classified as potential release sites. One is an oil release near Building 6597 (soil contamination) and the other is trichloroethylene contamination (potential groundwater contamination) near the guard gate on the north side of the TA. Both of these sites are under investigation (SNL/NM 2001a). More information on regulatory requirements for waste disposal is provided in Chapter 6.

Table 4–33 Waste Generation Rates and Inventories at SNL/NM

Waste Type	*Generation Rate (cubic meters per year)*	*Inventory (cubic meters)*
Low-level radioactive	577	336
Mixed low-level radioactive	143	152
Hazardous (in kilograms)		
Resource Conservation and Recovery Act	36,965	Not applicable [a]
Toxic Substance Control Act	122,000	Not applicable [a]
Nonhazardous		
Liquid	1,060,000	Not applicable [a]
Solid	2,100	Not applicable [a]

[a] Generally, hazardous and nonhazardous wastes are not held in long-term storage.
Source: DOE 1999f.

Table 4–34 Waste Management Capabilities at SNL/NM[a]

Facility Name/Description	*Capacity*	*Status*	*Applicable Waste Type*		
			Low-Level Radioactive Waste	*Mixed Low-Level Radioactive Waste*	*Hazardous*
Treatment Facility (cubic meters per year)					
RMWMF [b]	61,326	Online		X	
HBWSF [b]	61,326	Online		X	
Thermal Treatment Facility (in kilograms)	136	Online			X [c]
Storage Facility (cubic meters)					
RMWMF in TA-III	8,000	Online	X	X	
High bay (6596) in TA-I	1,800	Online	X	X	
Interim storage site in TA-III	510	Online	X	X	
Manazno bunkers [d]	1,556	Online	X	X	
HWMF Waste Packaging Building 959	22	Online			X
HWMF Waste Packaging Building 958	227	Online			X
HWMF Modular Storage Buildings	38	Online			X

RMWMF = Radioactive and Mixed Waste Management Facility; HBWSF = High Bay Mixed Waste Storage Facility; HWMF = Hazardous Waste Management Facility

[a] There are no treatment, storage or disposal facilities for nonhazardous wastes located at SNL/NM. Off site facilities are used.
[b] Treatment options are discussed in the SNL/NM Site Treatment Plan. Final approval of treatment options is not expected prior to renewal of the existing hazardous waste permit sometime after 2000. DOE has paid annual operating fees associated with the treatment units since 1996.
[c] Treatment of explosive waste.
[d] Includes Manazno Bunkers 37034, 37045, 37055, 37057, 37063, 37078, 37118.
Source: DOE 1999f.

4.3.12.2 Low-Level Radioactive Waste

SNL/NM generates low-level radioactive waste as a result of research and development activities. Small quantities of low-level radioactive waste can be received periodically from remote test facilities including Kauai, Hawaii; White Sands Missile Range, New Mexico; and Tonopah Test Range, Nevada. Most of the low-level radioactive waste consists of contaminated equipment and combustible decontamination materials and cleanup debris. The Radioactive and Mixed Waste Management Facility in TA-III processes low-level radioactive waste to meet the waste acceptance criteria of designated DOE disposal sites (DOE 1996f).

4.3.12.3 Mixed Low-Level Radioactive Waste

In general, mixed low-level radioactive waste is generated during laboratory experiments and components testing. Mixed low-level radioactive waste generated at SNL/California has also been shipped to SNL/NM for management in accordance with a New Mexico Environment Department compliance order issued under the Federal Facility Compliance Act.

SNL/NM has the capability to treat some mixed wastes on site at the Radioactive and Mixed Waste Management Facility and the High Bay Mixed Waste Storage Facility. Treatment options include thermal treatment, neutralization, chemical treatment, centrifugation, encapsulation, flocculation, physical treatment, reverse osmosis, and mechanical processing.

Processing includes activities required to comply with the waste acceptance criteria and Federal regulations. Pursuant to the Federal Facility Compliance Act, SNL/NM developed a site treatment plan for mixed wastes. The site treatment plan is intended to bring SNL/NM into compliance with land disposal restrictions (storage prohibitions) under the New Mexico Hazardous Waste Act and RCRA. DOE submitted a proposed site treatment plan, and on October 6, 1995, a Compliance Order was issued by the State of New Mexico requiring SNL/NM to comply with the site treatment plan for the treatment of mixed wastes at SNL/NM (DOE 1996f).

4.3.12.4 Hazardous Waste

The Hazardous Waste Management Facility, located in TA-II, performs safe handling, packaging, short-term storage, and shipping of all RCRA-regulated, Toxic Substances Control Act-regulated, and other hazardous and toxic waste categories, except explosives. The hazardous waste generated at SNL/NM predominantly results from experiments, testing, research and development activities, and infrastructure fabrication and maintenance. Environmental restoration and decontamination and decommissioning also generate hazardous waste. In addition, SNL/NM manages small amounts of waste from other operations such as SNL/NM's Advanced Materials Laboratory on the University of New Mexico campus in Albuquerque or DOE's Albuquerque Operations Office.

Hazardous waste generated by SNL/NM is collected and transported to the Hazardous Waste Management Facility for packaging and short-term (less than one year) storage prior to offsite transportation for recycling, treatment, or disposal at a licensed facility.

The Thermal Treatment Facility, located in the northeast corner of TA-III, is used to thermally treat small quantities of waste explosive substances, waste liquids contaminated with explosive substances, and waste items (e.g., rags, wipes, and swabs) contaminated with explosive substances. No radioactive waste is treated at the Thermal Treatment Facility.

4.3.12.5 Nonhazardous Waste

Solid waste consists predominantly of office and nonhazardous laboratory trash. It does not include food waste from cafeteria operations, which is managed under a separate contract with the U.S. Air Force. Nonhazardous building debris generated from decontamination and decommissioning activities may also be considered solid waste; however, it is currently managed at KAFB. After nonhazardous solid waste is transferred to the Solid Waste Transfer Facility, it is screened for improperly disposed of, potentially hazardous materials, which are removed from the trash and disposed of through appropriate processes. All solid waste is currently disposed of at the Rio Rancho Sanitary Landfill in Rio Rancho, New Mexico.

In 1996, the SNL/NM sewer system consisted of a 64-kilometer (40-mile) underground pipe network that discharged approximately 1 million liters (280 million gallons) of industrial and domestic wastewater. Wastewater has leaked from underground sewer lines. Possible soil contamination associated with these leaks is being investigated and cleaned up as part of the Environmental Restoration Project.

4.3.12.6 Waste Minimization

SNL/NM has an active waste minimization and pollution prevention program to reduce the total amount of waste generated and disposed of at the site. This is accomplished by eliminating waste through source reduction or material substitution; by recycling potential waste materials that cannot be minimized or eliminated; and by treating all of the waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. Achievements and progress in this area have been updated at least annually. Implementing pollution prevention projects reduced the total amount of waste generated at SNL/NM in 1999 by approximately 8 cubic meters (10.5 cubic yards). Examples of pollution prevention projects completed in 1999 at SNL/NM include the reduction of sanitary waste by 5,895 metric tons (6,496 tons) by crushing concrete and asphalt material for reuse, thereby eliminating the need to purchase new materials (DOE 2000i).

4.3.12.7 Waste Management PEIS Records of Decision

The *Waste Management PEIS* Records of Decision affecting SNL/NM are shown in **Table 4–35**. Decisions on the various waste types were announced in a series of Records of Decisions published after publication of the *Waste Management PEIS* (DOE 1997a). The hazardous waste Record of Decision was published on August 5, 1998 (63 FR 41810), and the low-level radioactive and mixed low-level radioactive waste Record of Decision was published on February 18, 2000 (65 FR 10061). The hazardous waste Record of Decision states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of nonwastewater hazardous waste. The Oak Ridge Reservation and the Savannah River Site will continue treating some of their own nonwastewater hazardous waste on site in existing facilities, where this is economically feasible. The low-level radioactive waste and mixed low-level radioactive waste Record of Decision states that, for the management of low-level radioactive waste, minimal treatment will be performed at all sites and onsite disposal will continue, to the extent practicable, at INEEL, LANL, the Oak Ridge Reservation, and the Savannah River Site. In addition, Hanford and NTS will be available to all DOE sites for low-level radioactive waste disposal. Mixed low-level radioactive waste will be treated at Hanford, INEEL, the Oak Ridge Reservation, and the Savannah River Site, and will be disposed of at Hanford and NTS. More detailed information concerning DOE's decisions for the future configuration of waste management facilities at SNL/NM is presented in the hazardous waste and low-level radioactive waste and mixed low-level radioactive waste Records of Decision.

Table 4–35 Waste Management PEIS Records of Decision Affecting SNL/NM

Waste Type	*Preferred Action*
Low-level radioactive	DOE has decided to treat SNL/NM's low-level radioactive waste on site and to ship the waste to either the Hanford Site or NTS for disposal.[a]
Mixed low-level radioactive	DOE has decided to regionalize treatment of mixed low-level radioactive waste at the Hanford Site, INEEL, the Oak Ridge Reservation, and the Savannah River Site. DOE has decided to ship SNL/NM's mixed low-level radioactive waste to either the Hanford Site or NTS for disposal.[a]
Hazardous	DOE has decided to continue to use commercial facilities for treatment of SNL/NM's nonwastewater hazardous waste. [b]

[a] From the Record of Decision for low-level radioactive and mixed low-level radioactive waste (65 FR 10061).
[b] From the Record of Decision for hazardous waste (63 FR 41810).
Sources: 65 FR 10061, 63 FR 41810.

4.4 NEVADA TEST SITE

NTS is located on approximately 365,100 hectares (880,000 acres) in southern Nye County, Nevada. The site is located 105 kilometers (65 miles) to the northwest of Las Vegas and 16 kilometers (10 miles) northeast of the California State line (see **Figure 4–22**). All of the land within NTS is owned by the Federal Government and is administered, managed, and controlled by DOE's NNSA. NTS contains approximately 900 buildings that provide approximately 259,300 square meters (2,790,600 square feet) of space. Many of these facilities have been either mothballed or abandoned because of the reduction of program activities at the site (DOE 1998b).

NTS (originally the Nevada Proving Grounds) was established in 1950 as an on-continent proving ground and has seen more than four decades of nuclear weapons testing. Since the nuclear weapons testing moratorium in 1992 and under the direction of DOE, test site use has diversified into many other programs. Programs currently conducted at NTS include those related to defense, waste management, environmental restoration, nondefense research and development, and work for others (DOE 1996e).

The Device Assembly Facility (DAF) is located in Area 6, which is situated within the east-central portion of NTS. This area occupies about 21,200 hectares (52,500 acres) between Yucca Flat and Frenchman Flat, straddling Frenchman Mountain. The area was used for one atmospheric and five underground nuclear tests between 1957 and mid-1990 (DOE 1996e). Unless otherwise referenced, the following descriptions of the affected environment at NTS and DAF are based all or in part on information provided in the *NTS SWEIS* (DOE 1996e), which is incorporated by reference.

4.4.1 Land Resources

4.4.1.1 Land Use

Federal lands surround NTS, with the Nellis Air Force Range Complex located on the north, east, and west, and U.S. Bureau of Land Management lands on the south and southwest. Beyond the Federal lands surrounding NTS, principal land uses in Nye County in the vicinity of the site include mining, grazing, agriculture, and recreation. Of the total land area within the county, only a small number of isolated areas are under private ownership and, therefore, are subject to general planning guidelines. Rural communities located within the vicinity of NTS include Alamo, 69 kilometers (43 miles) to the northeast; Pahrump, 42 kilometers (26 miles) to the south; Beatty, 26 kilometers (16 miles) to the west; and Amargosa Valley, 5 kilometers (3 miles) to the south.

Clark County, Nevada, lies immediately to the east of NTS. The Federal Government owns 95 percent of the county. Primary land uses on these Federal lands include open grazing, mining, and recreation. Outdoor recreational areas located in the vicinity of NTS include Lake Mead National Recreation Area, 121 kilometers (75 miles) to the east; Red Rock National Conservation Area, 64 kilometers (40 miles) to the southwest; Death Valley National Monument, 19 kilometers (12 miles) to the west-southwest; and Desert National Wildlife Range, 5 kilometers (3 miles) to the east. Several state parks are also located within 80 kilometers (50 miles) of NTS.

Land use zone categories at NTS include the Nuclear Test Zone, Nuclear and High Explosives Test Zone, Research Test and Experiment Zone, Radioactive Waste Management Zone, Solar Enterprise Zone, Defense Industrial Zone, and Reserved Zone (**Figure 4–23**). In most cases, an area is assigned to a use category based on the environmental characteristics it exhibits. Environmental characteristics, especially geography and geology, generally determine how suitable an area is for a particular use. Technical and experimental areas cluster in those sectors of NTS where geography and geology are most favorable to testing (DOE 1998b).

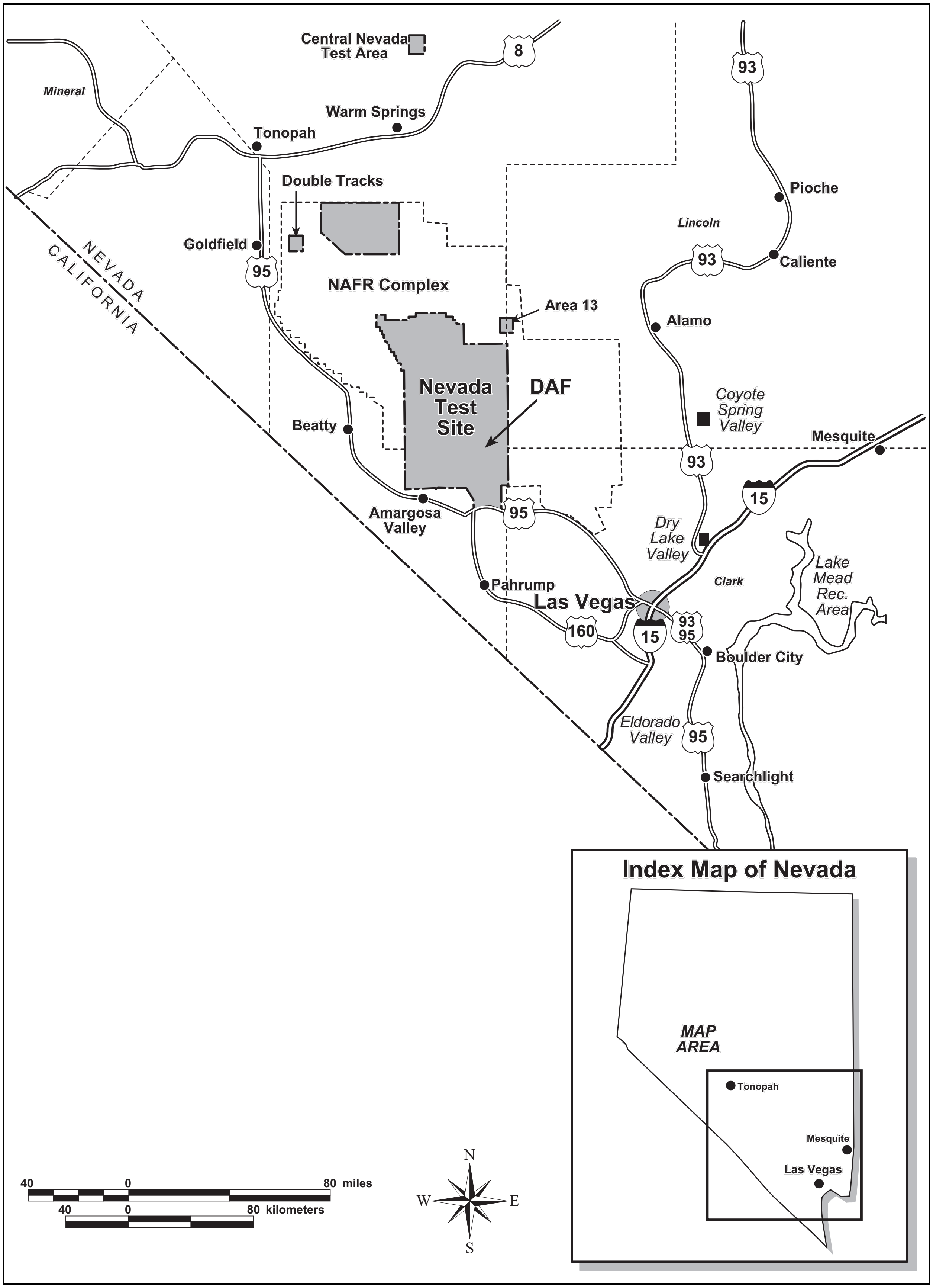
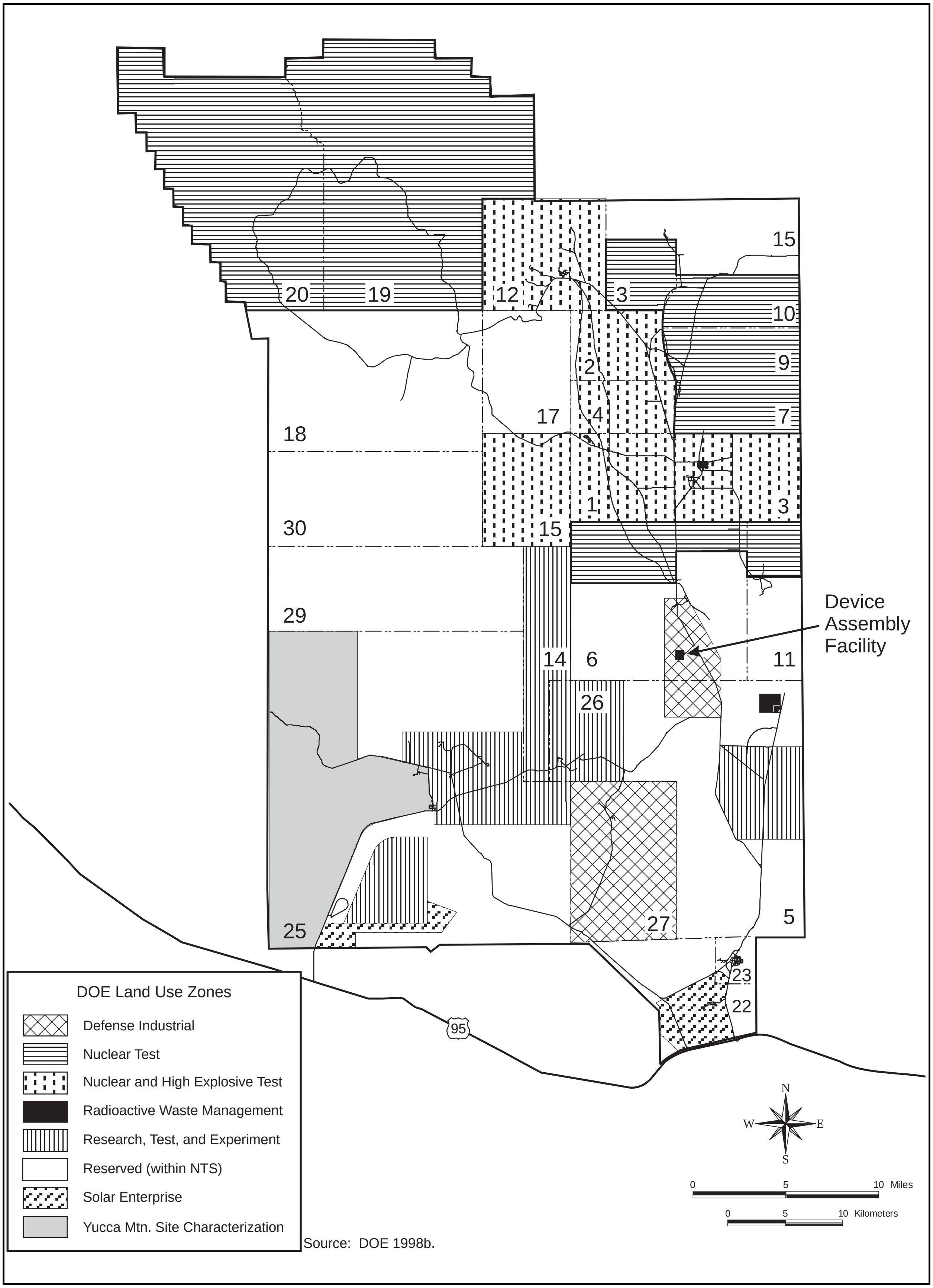


Figure 4–22 Location of NTS



Source: DOE 1998b.

Figure 4–23 Land Use at the Nevada Test Site

Approximately 45 percent of NTS is currently unused or provides buffer zones for ongoing programs or projects, while about 7 to 10 percent (24,300-35,000 hectares [60,000-86,500 acres]) of the site has been disturbed. The following information describes the land use zones.

Nuclear Test Zone—This area is reserved for dynamic experiments, hydrodynamic tests, and underground nuclear weapons and weapons effects tests. This zone includes compatible defense and nondefense research, development, and testing activities.

Nuclear and High Explosives Test Zone—This area is designated within the Nuclear Test Zone for additional underground nuclear weapons tests and outdoor high explosive tests. This zone includes compatible defense and nondefense research, development, and testing activities.

Research Test and Experiment Zone—This area is designated for small-scale research and development projects and demonstrations; pilot projects; outdoor tests; and experiments related to the development, quality assurance, or reliability of material and equipment under controlled conditions. This zone includes compatible defense and nondefense research, development, and testing projects and activities.

Radioactive Waste Management Zone—This area is designated for the management of radioactive wastes.

Solar Enterprise Zone—The area is designated for the development of a solar power generation facility, as well as light industrial equipment and commercial manufacturing capabilities.

Defense Industrial Zone—This area is designated for stockpile management of weapons, including production, assembly, disassembly or modification, staging, repair, retrofit, and surveillance. Also included in this zone are permanent facilities for stockpile stewardship operations involving equipment and activities such as radiography, lasers, material processing, and pulsed power.

Reserved Zone—This area includes land and facilities that provide widespread flexible support for diverse short-term testing and experimentation. The reserved zone is also used for short-duration exercises and training such as nuclear emergency response and Federal Radiological Monitoring and Assessment Center training and Department of Defense (DoD) land-navigation exercises and training.

NTS is part of the National Environmental Research Park network, although certain areas of the site are excluded from this designation because of operations or other activities related to the primary mission of the site. The National Environmental Research Park designation provides for research into biological diversity, plant and community development in disturbed and undisturbed landscapes, regional climate trends, soil formation differences, and other factors that control environmental conditions. Additionally, the compatibility of the environment with energy technology options can be studied (DOE 1998b).

Land-use planning does not occur at the state level in Nevada; however, counties and other municipalities may plan if they so choose. The recently adopted Nye County comprehensive plan is a policy document that permits the county to begin a process of establishing a comprehensive land-use plan and zoning ordinance. No municipalities within Nye County have adopted land-use plans, policies, or controls (DOE 1996g).

Three land use zones occur in Area 6 (Figure 4–23). The northern quarter of the area is designated as the Nuclear Test Zone, the south central portion is categorized as the Defense Industrial Zone, and the remaining area is designated as the Reserved Zone. DAF, which occupies 12 hectares (29 acres) of land, is located within the Defense Industrial Zone (DOE 1995d). The facility is isolated from other structures and is surrounded by desert (Figure 3–9).

4.4.1.2 Visual Resources

NTS is located in a transition area between the Mojave Desert and the Great Basin. Vegetation characteristic of both deserts is found on the site. The topography of the site consists of a series of north-south-oriented mountain ranges separated by broad, low-lying valleys and flats. Site topography is also characterized by the presence of numerous subsidence craters resulting from past nuclear testing. The southwestern Nevada volcanic field, which includes portions of NTS, is a nested, multicaldera volcanic field. The facilities of NTS are widely distributed across this desert setting.

The area surrounding NTS is unpopulated to sparsely populated desert and rural land. Access to areas that would have views of the site is controlled by NTS or the U.S. Air Force; therefore, few viewpoints are accessible to the general public. Public viewpoints of NTS along U.S. Route 95, the principal highway between Tonopah and Las Vegas, are limited to Mercury Valley due to the various mountain ranges surrounding the southern boundary of the site. The primary viewpoint in Mercury Valley is a roadside turnoff containing Nevada Historical Marker No. 165 of the Nevada State Park System, entitled "Nevada Test Site." NTS facilities within 8 kilometers (5 miles) are visible from this viewpoint. The main base camp at Mercury, located in Area 23, is well defined at night by facility lighting. Lands within NTS have a Visual Resource Contrast rating of Class II or III. Management activities within these classes may be seen, but should not dominate the view. Developed areas within the site are consistent with a Visual Resource Contrast Class IV rating in which management activities dominate the view and are the focus of viewer attention.

DAF is located in Area 6, which covers about 21,200 hectares (53,500 acres) between Yucca Flat and Frenchman Flat, straddling Frenchman Mountain. Developed areas are widespread. DAF is a 9,290-square-meter (100,000-square-foot) facility that has a low profile and is covered with a minimum of 1.5 meters (5 feet) of earth. Several small building and parking lots surround DAF itself. Areas within and immediately adjacent to the facility are bare ground; the site is surrounded by desert. As is the case for NTS as a whole, undeveloped portions of the Area 6 have a Visual Resource Contrast Class II or III, while developed portions, including DAF, have a Visual Resource Contrast Class IV rating.

4.4.2 Site Infrastructure

Site infrastructure characteristics for NTS are summarized in **Table 4–36**.

Table 4–36 NTS Sitewide Infrastructure Characteristics

Resource	*Site Usage*	*Site Capacity*
Transportation		
Roads (kilometers)	1,127 [a]	Not applicable
Railroads (kilometers)	0	Not applicable
Electricity		
Energy consumption (megawatt-hours per year)	101,377	176,844
Peak load (megawatts)	27	45
Fuel		
Natural gas (cubic meters per year)	0	Not applicable
Liquid Fuels (liters per year)	4,201,805	Not limited
Coal (metric tons per year)	0	Not applicable
Water (liters per year)	832,000,000	5,150,000,000 [b]

[a] Includes paved and unpaved roads.
[b] Sustainable water production capacity of all site wells.
Sources: DOE 1996e, DOE 1998b, DOE 2000j.

4.4.2.1 Ground Transportation

About 644 kilometers (400 miles) of paved roads have been developed out of the 1,127 kilometers (700 miles) of roads on the site (Table 4–36). There is no railway service connection to NTS. Local and linking transportation systems, including roadways, are detailed in Section 4.4.9.4.

4.4.2.2 Electricity

Electric power is delivered to NTS at the Mercury switching center in Area 22 by a primary 138-kilovolt supply line from the Nevada Power Company system near Las Vegas. A second Nevada Power Company-owned 138-kilovolt line connects the Mercury switching center to the Jackass Flats substation in Area 25. Valley Electric Cooperative, serving the Pahrump, Nevada, area, also has a transmission connection to the Jackass Flats substation. The dual transmission and station connections provide NTS with the ability to receive service from either transmission source depending on contractual arrangements. A DOE-owned 138-kilovolt loop extends this primary power supply into NTS forward areas where smaller, lower-voltage distribution lines feed power to individual facilities. During the last several years, NTS has been provided power under contracts with Nevada Power Company and the Western Area Power Administration. Additionally, DOE has periodically operated oil-fired diesel generators at Area 25 for peak and back-up power supply purposes. Electric power at NTS is carried over 426 kilometers (265 miles) of transmission and subtransmission lines.

NTS electrical capacity is about 177,000 million megawatt-hours per year. In 2000, NTS electrical usage was about 101,000 megawatt-hours (Table 4–36). Peak load usage is 27 megawatts with a site peak load capacity of 45 megawatts (DOE 1996g).

4.4.2.3 Fuel

Liquid fuels are the principal fuel resources used at NTS (DOE 1996g). No coal or natural gas is used. Unleaded gasoline and diesel fuel are available at NTS. The fuel capacity in Mercury is 45,424 liters (12,000 gallons) of unleaded gasoline and 37,853 liters (10,000 gallons) of diesel fuel. The bulk fuel storage capacity in Mercury is 1,589,826 liters (420,000 gallons) of both unleaded gasoline and diesel fuel. The fuel capacity in Area 6 is 75,706 liters (20,000 gallons) for both unleaded gasoline and diesel fuel. The bulk fuel storage capacity in Area 6 is 158,983 liters (42,000 gallons) of unleaded gasoline and 397,457 liters (105,000 gallons) of diesel fuel. The fuel capacity in Area 12 is 75,706 liters (20,000 gallons) of unleaded gasoline (DOE 1998b).

NTS used approximately 4.2 million liters (1.1 million gallons) of liquid fuels in 2000. In 2000, DAF used about 83,000 liters (22,000 gallons) of liquid fuels.

4.4.2.4 Water

NTS is presently served by a water system divided into four service areas consisting of 11 wells for potable water, two wells for nonpotable water, some 30 usable storage tanks, 13 usable construction water sumps, and 6 water transmission systems (with 4 permitted water distribution systems and 3 permitted water trucks in 1999). One potable well (Well C) was inactive again in 1998 due to a failed pump (DOE 2000j). The wells are not being used to their full capacity and are capable of producing much more water if needed. Additional inactive wells are available, or wells may be drilled and developed if increased water production is required. Wells, sumps, and storage tanks are used, as required, to support construction or operational activities. Domestic, construction, and fire protection water are supplied by this system through over 161 kilometers (100 miles) of supply line. Potable water is trucked to support facilities that are not connected to the potable water system. The maximum production capacity of the site potable supply wells is approximately 8.0 billion liters (2.1 billion gallons) per year. The sustainable site production capacity has been estimated at a level of approximately 5.15 billion liters (1.36 billion gallons) annually which equates to the historical maximum production level without measurable impact on the regional groundwater system. NTS has adopted this production level and hydrographic basin-specific levels for planning purposes in accordance with sound resource management principals (DOE 1998b). Water rights appropriated under the Federal Reserve Water Rights Doctrine essentially grants an unquantified water right to support NTS missions. However, downgradient groundwater users have challenged DOE's water rights under the states water appropriations process (DOE 1998b). NTS used approximately 832 million liters (219.8 million gallons) of water in 1999 (DOE 2000j).

Area 6 of NTS is in water service area C which also encompasses Areas 1, 3, 5, 11, 22, 23, 26, and 27. Supply wells 4, 4a, C, and C1 provide potable water service to facilities in these areas including DAF. Combined, these wells have a maximum production capacity of approximately 2.55 billion liters (672 million gallons) per year (DOE 1998b).

4.4.3 Air Quality

The climate at NTS is characterized by limited precipitation, low humidity, and large diurnal temperature ranges. The lower elevations are characterized by hot summers and mild winters, which are typical of other Great Basin areas. As elevation increases, precipitation increases and temperatures decrease.

Annual precipitation at higher NTS elevations is about 23 centimeters (9 inches), including snow accumulations. The lower elevations receive approximately 15 centimeters (6 inches) of precipitation annually, with occasional snow accumulations lasting only a few days.

Precipitation in the summer falls in isolated showers, which cause large variations among local precipitation amounts. Summer precipitation occurs mainly in July and August, when intense heating of the ground beneath moist air masses triggers thunderstorm development and associated lightning. A tropical storm occasionally will move northeastward from the coast of Mexico, bringing heavy precipitation during September and October.

Elevation influences temperatures at NTS. At an elevation of 2,000 meters (6,560 feet) on Pahute Mesa, the average daily maximum and minimum temperatures are 4 °C to -2 °C (40 °F to 28 °F) in January and 27 °C to 17 °C (80 °F to 62 °F) in July. In the Yucca Flat weapons test basin, at an elevation of 1,195 meters (3,920 feet), the average daily maximum and minimum temperatures are 11 °C to -6 °C (51 °F to 21 °F) in January, and 36 °C to 14 °C (96 °F to 57 °F) in July. Elevation at Mercury is 1,314 meters (4,310 feet), and the extreme temperatures are 21 °C to -11 °C (69 °F to 12 °F) in January and 43 °C to 15 °C (109 °F to 59 °F) in July.

The annual average temperature in the NTS area is 19 °C (66 °F). Monthly average temperatures range from 7 °C (44 °F) in January to 32 °C (90 °F) in July. Relative humidity readings (taken four times per day) range from 11 percent in June to 55 percent in January and December.

Average annual wind speeds and direction vary with location. At higher elevations on Pahute Mesa, the average annual wind speed is 4.5 meters per second (10 miles per hour). The prevailing wind direction during winter months is north-northeasterly, and during summer months winds are southerly.

In the Yucca Flat weapons test basin, the average annual wind speed is 3 meters per second (7 miles per hour). The prevailing wind direction during winter months is north-northwesterly, and during summer months is south-southwesterly. At Mercury, the average annual wind speed is 4 meters per second (8 miles per hour) with northwesterly prevailing winds during winter months, and southwesterly prevailing winds during summer months.

Wind speeds in excess of 27 meters per second (60 miles per hour), with gusts up to 48 meters per second (107 miles per hour), may be expected to occur once every 100 years. Additional severe weather in the region includes occasional thunderstorms, lightning, tornadoes, and sandstorms. Severe thunderstorms may produce high precipitation that continues for approximately one hour and may create a potential for flash flooding. Few tornadoes have been observed in the region, and they are not considered a significant event. The estimated probability of a tornado striking a point at NTS is extremely low (3 in 10 million years).

4.4.3.1 Nonradiological Releases

NTS is located in Nevada Intrastate Air Quality Control Region (#147). The region has been designated as attainment with respect to the National Ambient Air Quality Standards (NAAQS). The nearest nonattainment area is the Las Vegas area, located 105 kilometers (65 miles) southeast of NTS. Las Vegas Valley Hydrographic Area 212, located in Clark County, is classified as moderate nonattainment for carbon monoxide and serious nonattainment for fugitive dust (PM_{10}). The remaining portion of Clark County is designated as unclassifiable/attainment for these pollutants (40 CFR Part 81.329).

The nearest Prevention of Significant Deterioration Class I areas to NTS are the Grand Canyon National Park, 208 kilometers (130 miles) to the southeast, and the Sequoia National Park, 169 kilometers (105 miles) to the southwest. NTS has no sources subject to Prevention of Significant Deterioration requirements.

The criteria air pollutants emitted at NTS include particulates from construction, aggregate production, surface disturbances, and fugitive dust from vehicles traveling on unpaved roads; various pollutants from fuel-burning equipment, incineration, and open burning; and volatile organics from fuel storage facilities. A summary of emission estimates for sources at NTS is presented in **Table 4–37**. Emissions of hazardous air pollutants from current NTS sources are below regulatory requirements.

Table 4–37 NTS Source Emission Inventory in 1993

Pollutant	*Source*	*Emissions (kilograms per hour)*
PM_{10}	Area 12 boiler	1.3
	Area 23 boiler	1.6
	Area 23 boiler	1.3
	Area 23 incinerator	0.34
	Area 6 boiler	1.3
	Area 1 rotary dryer	3.2
Sulfur dioxide	Area 12 boiler	1.3
	Area 23 boiler	1.4
	Area 23 boiler	1.3
	Area 23 incinerator	1.4
	Area 6 boiler	1.1

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter.
Source: DOE 1996e.

Ambient air quality at NTS is not currently monitored for criteria pollutants or hazardous air pollutants, with the exception of radionuclides. Elevated levels of ozone or particulate matter may occasionally occur because of pollutants transported into the area or because of local sources of fugitive particulates. Ambient concentrations of other criteria pollutants (sulfur dioxide, nitrogen oxides, carbon monoxide, and lead) are probably low because there are no large sources of these pollutants nearby. The nearest area with air pollutant sources of concern is the Las Vegas area. Ambient air quality data for NTS is summarized in **Table 4–38**. These measurements were recorded during the period from August 15 through September 15, 1990. Monitoring stations were located in Area 23 at Building 525; Area 6 at Building 170; and Area 12 at the sanitation department office trailer. DAF is located in Area 6. Based on the data collected during this study, NTS is well within all applicable Federal and state ambient air quality standards.

Table 4–38 Ambient Air Quality Data for NTS [a]

Pollutant	*Averaging Period*	*Most Stringent Standard [b] (micrograms per cubic meter)*	*Monitored Concentration (micrograms per cubic meter)*		
			Area 23	*Area 6*	*Area 12*
Carbon monoxide					
less than 5,000 feet above mean sea level	8 hours	10,000	1,370	1,150	2,290
at any elevation	1 hour	40,000	1,370	1,950	2,750
Lead	Quarterly	1.5	(d)	(d)	(d)
Nitrogen dioxide	Annual	100	(d)	(d)	(d)
Ozone [c]	1 hour	235	(d)	(d)	(d)
PM_{10}	Annual	50	(d)	(d)	(d)
	24 hours	150	78.3	20.2	45.4
Sulfur dioxide	Annual	80	(d)	(d)	(d)
	24 hours	365	39.3	(d)	15.7
	3 hours	1,300	65.4	(d)	52.4

PM_{10} = particulate matter less than or equal to 10 microns in aerodynamic diameter

[a] Nevada also has ambient standards for visibility and hydrogen sulfide. Measurements recorded from August 15 to September 15, 1990.

[b] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The NAAQS (40 CFR Part 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic PM_{10} mean standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[c] Another standard applies at Lake Tahoe Basin.

[d] Not measured.

Sources: Nevada Administrative Code 445B.391, DOE 1996e.

The existing ambient air concentrations attributable to sources at NTS are expected to represent a small percentage of the ambient air quality standards. No modeled concentrations are available showing the site contributions to ambient concentrations at the site boundary.

4.4.3.2 Radiological Releases

During 1998, an estimated 363 curies of tritium and 0.24 curies of plutonium-239/240 were released to the atmosphere at NTS. These releases were attributed to: (1) diffusion of tritiated water vapor from evaporation from tunnel and characterization well containment ponds, (2) diffuse emissions calculated from the results of environmental surveillance activities, and (3) resuspension of plutonium as measured with air sampling equipment or calculated by use of resuspension equations. The releases and their sources are presented in **Table 4–39**. None of the releases were from Area 6, where DAF is located.

Table 4–39 Radiological Airborne Releases to the Environment at NTS in 1999

Radionuclide	Source	Release (curies)
Tritium (Hydrogen-3)	Containment ponds	24.7 [a]
	Laboratories	5.7
	SCHOONER	65
	Sedan Crater, Area 10	260
	Area 5, Radioactive Waste Management Site	7.1
Plutonium-239/240	Areas 3 and 9	0.04
	Other Areas [b]	0.20

[a] Evaporation from the containment ponds.
[b] There were no radioactive releases from Area 6 in 1999.
Source: DOE 2000j.

4.4.4 Noise

The major noise sources at NTS include equipment and machines (e.g., cooling towers, transformers, engines, pumps, boilers, steam vents, paging systems, construction and material-handling equipment, and vehicles), blasting and explosives testing, and aircraft operations. No NTS environmental noise survey data are available. At the NTS boundary, away from most facilities, noise from most sources is barely distinguishable above background noise levels.

The acoustic environment in areas adjacent to NTS can be classified as either uninhabited desert or small rural communities. In the uninhabited desert, the major sources of noise are natural physical phenomena such as wind, rain, and wildlife activities, and an occasional airplane. The wind is the predominant noise source. Desert noise levels as a function of wind have been measured at an upper limit of 22 decibels A-weighted (dBA) for a still desert and 38 dBA for a windy desert.

A background sound level of 30 dBA is a reasonable estimate. This is consistent with other estimates of sound levels for rural areas. The rural communities day-night average sound level has been estimated in the range of 35 to 50 decibels (dB) (EPA 1974). A background sound level of 50 dB is a reasonable estimate for Mercury.

Except for the prohibition of nuisance noise, neither the State of Nevada nor local governments have established specific numerical environmental noise standards.

4.4.5 Geology and Soils

NTS and surrounding areas are in the southern part of the Great Basin, the northern most subprovince of the Basin and Range Physiographic Province. This region is generally characterized by more or less regularly spaced, generally north-south trending mountain ranges separated by alluvial basins that were formed by faulting. The Great Basin subprovince is a closed drainage basin, i.e., precipitation that falls over the basin has no outlet to the Pacific Ocean. The relief of NTS is considerable, ranging from less than 1,000 meters (3,280 feet) above sea level in Frenchman Flat and Jackass Flats to about 2,339 meters (7,675 feet) on Rainier Mesa. There are three primary valleys at NTS: Yucca Flat, Frenchman Flat, and Jackass Flats. Both Yucca Flat and Frenchman Flat are topographically closed, with playas in the lowest portions of each basin. Jackass Flats is topographically open with drainage via the Fortymile Wash off NTS.

The topography of NTS has been altered by historic DOE actions, particularly underground nuclear testing. The principal effect of testing has been the creation of numerous craters in Yucca Flat basin and a lesser number of craters on Pahute and Rainier Mesas.

NTS is underlain by a thick section (more than 10,597 meters [34,768 feet]) of Paleozoic (Permian to Cambrian) age (245 to 570 million years old) and older sedimentary rocks, locally intrusive Cretaceous age (66 to 145 million years old) granitic rocks, a variable assemblage of middle to late Tertiary (Miocene) age (5 to 24 million years old) volcanic rocks, and locally thick deposits of postvolcanic sands and gravels that fill the present day valleys. Additional details about NTS site geology are presented in the *NTS SWEIS*.

Extensive rock and mineral resources are present in the NTS region. A number of mines were developed into districts within the region from the early 1900s to the late 1970s. Significant gold and silver deposits may be present east of Goldfield in the northwestern Nellis Air Force Range Complex located north of NTS. Small amounts of tungsten were produced from the Oak Spring mining district at the north end of Yucca Flat, and silver, copper, lead, zinc, molybdenum sulfides are also known to be present. Economic quantities of silver, copper, lead, and zinc have been recovered from the Groom mine in this area. The Calico Hills and Mine Mountain mining districts within NTS exhibit copper, silver, lead, zinc, and mercury sulfides in fractured carbonate and clastic rocks. Free gold with silver sulfides occurs at the surface associated with mine workings developed within the Wahmonie mining district located east of Jackass Flats and north of Skull Mountain. Industrial minerals such as uranium may be present in the northwestern part of the Nellis Air Force Range Complex. Other potential industrial mineral resources include barite and possibly fluorite. Most of the alluvial valleys in the region have aggregate resources at least along the flanks of adjacent mountains. NTS is considered a valuable source of these resources to meet future demand. Hot springs are common in the province and, if water temperatures near Yucca Mountain are representative, water temperatures in the region may be insufficient for commercial geothermal power development (DOE 1998b).

NTS is also crossed by numerous faults (**Figure 4–24**). Three major fault zones in the region may be currently active (Mine Mountain, Cane Spring, and Rock Valley) and thus are deemed capable per the U.S. Nuclear Regulatory Commission definition (10 CFR 100, Appendix A). Small earthquakes recently occurred at or near the Cane Spring Fault zone and the Rock Valley Fault zone, although no surface displacement was associated with either of these earthquakes. The Cane Spring fault is thought to have been the source of a magnitude 4.3 earthquake in August 1971. In February 1973, an earthquake of magnitude 4.5 occurred along the Rock Valley Fault System (DOE 1998b). A fault near Little Skull Mountain in the southwest part of NTS was the location of a magnitude 5.6 (Richter magnitude 5.7) earthquake on June 28, 1992. This is the largest earthquake recorded within the boundaries of NTS and may have resulted from a magnitude 7.5 earthquake near Landers, California, that occurred less than 24 hours earlier. Although there was no surface rupture, the Little Skull Mountain earthquake was the first to cause significant damage to facilities at NTS. These facilities, however, were built prior to the more stringent building codes presently followed at NTS. Nevertheless, another earthquake was epicentered below Little Skull Mountain on September 13, 1992 and registered Richter magnitude 4.1 to 4.4, but caused no damage. It had a Mercalli Intensity of IV (DOE 1998b, USGS 2001f).

Additionally, Yucca Fault in the Yucca Flat weapons test basin has been active in the recent geologic past (Figure 4–24). This fault displaces surface alluvium by as much as 18 meters (60 feet). Displacement of this young surface alluvium indicates that movement on Yucca Fault has occurred within the last few thousand to tens of thousands of years; subsurface displacement along this fault is 213 meters (700 feet).

Seismic waves from nuclear explosions are believed to relieve tectonic stress, as manifested by earthquakes deeper than 3 kilometers (1.2 miles), aftershocks, and reactivation of nearby faults in the areas designated for nuclear device testing. Studies of nuclear-explosive tests show that these events can generate vertical and horizontal displacements on nearby existing faults. As much as 102 centimeters (40 inches) of vertical displacement and 15 centimeters (6 inches) of horizontal displacement have been observed. Parts of both the Yucca Fault and the Carpetbagger Fault have been reactivated from nearby testing of nuclear devices.

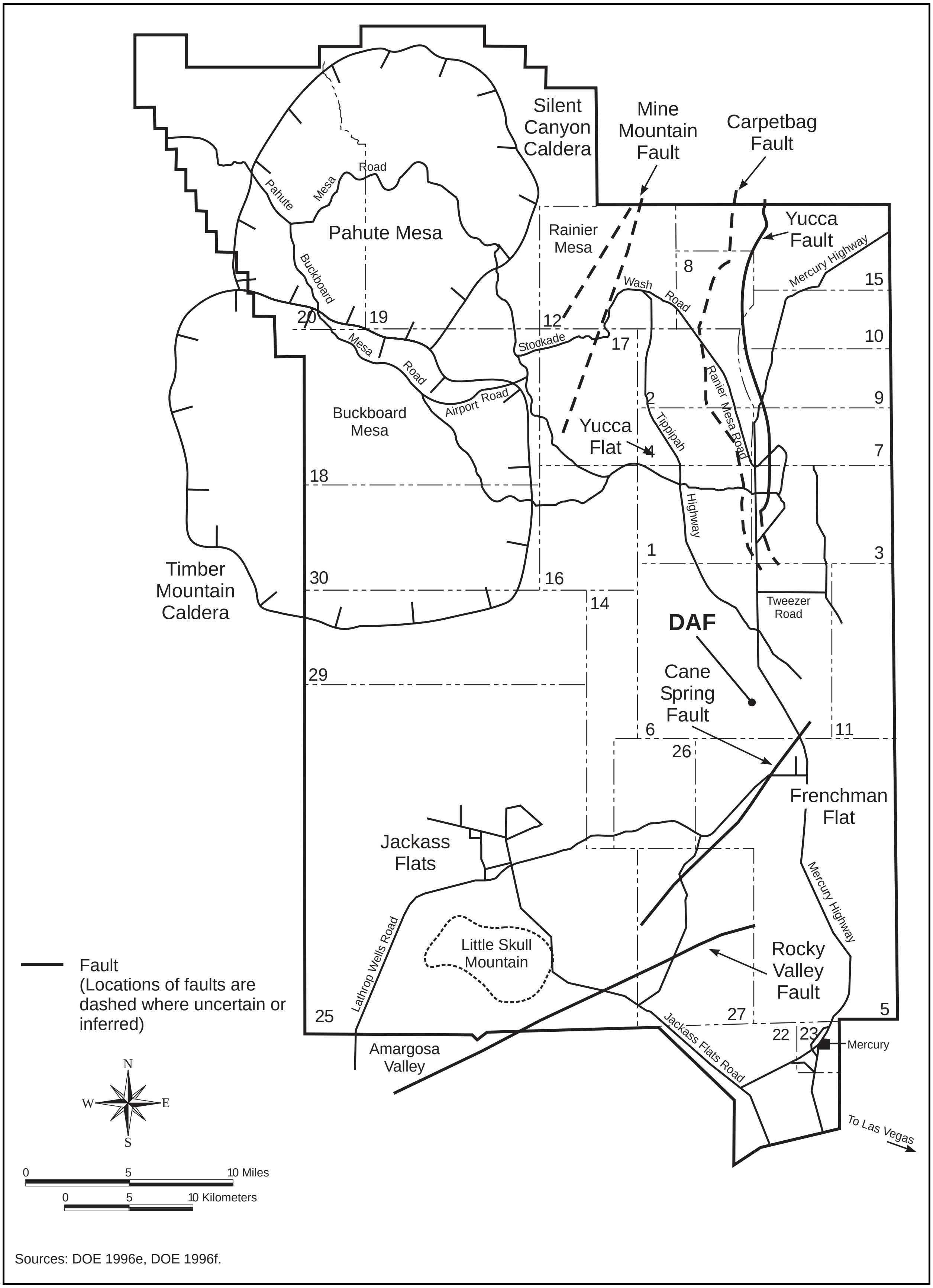


Figure 4–24 Major Faults at NTS

NTS lies in a region with relatively high seismicity and, as referenced above, the site is tectonically active. Within a radius of 100 kilometers (62 miles) of NTS (as measured from Area 6), a total of 7 significant earthquakes (i.e., having a magnitude of at least 4.5 or a Modified Mercalli Intensity of VI or larger) of natural origin have been documented. The largest of these was a Richter magnitude 5.13 earthquake in May 1967 centered 93 kilometers (58 miles) east-northeast of the site. None have been centered closer than 66 kilometers (41 miles) away (USGS 2001f). Since 1973, about 280 earthquakes in total (excluding those attributed to nontectonic sources) have been recorded within 100 kilometers (62 miles) of NTS, with the majority ranging in magnitude from 3 to 4 (USGS 2001g). Most notably, the June 29, 1992, magnitude 5.6 event located in the southwest portion of the site near Skull Mountain produced a maximum acceleration of 0.21g at Amargosa Valley (DOE 1996g). A Modified Mercalli Intensity was not attributed to this event (USGS 2001g). Also note that this earthquake is not listed among the significant earthquakes in the region despite its magnitude (USGS 2001f). Nevertheless, the region has remained seismically active. In calendar year 2000, there were four earthquakes recorded within 100 kilometers (62 miles) of the site. The closest of these was a September 9, 2000, Richter magnitude 3.0 event centered 27 kilometers (17 miles) southwest of Area 6 again near Little Skull Mountain (USGS 2001g). For reference, a comparison of Modified Mercalli Intensity (the observed effects of earthquakes) with measures of earthquake magnitude and ground acceleration is provided in Section F.5.2 (see Appendix F).

As discussed in more detail in Section 4.2.5, the U.S. Geological Survey has developed new earthquake hazard maps that are based on spectral response acceleration. These maps have been adapted for use in the new International Building Code (ICC 2000) and depict maximum considered earthquake ground motion of 0.2- and 1.0-second spectral response acceleration, respectively, based on a 2 percent probability of exceedance in 50 years (i.e., 1 in 2,500). NTS is calculated to lie within the 0.58g to 0.59g mapping contours for a 0.2-second spectral response acceleration and the 0.18g to 0.19g contours for a 1.0-second spectral response acceleration. For comparison, the calculated peak ground acceleration for the given probability of exceedance is approximately 0.26g (USGS 2001e).

Eruptions of the southwest Nevada volcanic field occurred primarily in the Middle Tertiary Period (around 24 million years ago). Successive eruptions produced no less than seven large and partially overlapping calderas, which were filled with lava flows and blanketed by vast deposits of volcanic tuff. As silicic volcanism that produced the large-volume ash flows of the Nevada volcanic field ended, basaltic volcanism began in the region about 11 million years ago. The episodes of basaltic volcanism were relatively low-volume and less explosive as compared to the earlier silicic eruptions (DOE 1999d). The basaltic eruptions produced small volcanoes and cinder cones that can be found in Crater Flat to the west of NTS (DOE 1999d). The youngest of these features is the Lathrop Wells volcano that could be as little as 75,000 years old. Expert analyses performed for the Yucca Mountain Project estimate that the probability of basaltic lava activity impacting the Yucca Mountain Repository located near the southwest boundary of NTS is about 1 in 7,000 over the first 10,000 years of repository operations (DOE 1999d). NTS lies about 240 kilometers (150 miles) southeast of the Long Valley area of California that has the potential for a volcanic eruption of the Mt. St. Helens type (DOE 1996g).

Soil studies to characterize site conditions have been limited at NTS. Soil loss through wind and water erosion is a common occurrence throughout NTS and surrounding areas. Limited areas of soils can be irrigated on NTS, and these occur only in the lower elevations of the Yucca Flat weapons test basin, Frenchman Flat, and Jackass Flats. Elsewhere on NTS, the soils are generally very limited in both thickness and areal extent. In general, soils across NTS have low available water-holding capacities and soil textures that are gradational from coarse-grained soils near the mountain fronts to fine-grained soils in the playa areas of the Yucca Flat weapons test basin and Frenchman Flat. Most soils are underlain by a hardpan of caliche in the lower elevations. Soil salinity generally increases dramatically in the direction of the playa areas, with the highest level of soluble salts accumulating in the deeper soil profile horizons in Frenchman Flat. The potential for soil erosion and shrink-swell also increases into the playas and basins, with the potential for water erosion increasing with slope. There is no prime farmland at NTS (DOE 1996g).

Soils on portions of NTS have been contaminated during the conduct of various testing and ancillary operations. The largest areas of surficial contamination are in the Yucca Flat weapons test basin, Frenchman Flat, Plutonium Valley, and in scattered locations in the western and northwestern parts of the facility. A comprehensive investigation is underway to determine the risks associated with this soil contamination, and actions will be taken as part of the environmental restoration program to reduce these risks, as appropriate.

DAF in NTS Area 6 is located on the northern boundary of Frenchman Flat. The nearest capable fault to DAF is the Cane Spring Fault, which is located about 5 kilometers (3 miles) southeast of the facility site (Figure 4–23). Surficial stratigraphy is dominated primarily by alluvial sediments that attain a thickness of approximately 332 meters (1,090 feet) near the DAF (NTS 2001).

4.4.6 Water Resources

4.4.6.1 Surface Water

NTS is located within the Great Basin, a closed hydrographic basin from which no surface water leaves except by evaporation. The Great Basin includes much of Nevada. There are no perennial streams or other naturally-occurring surface water bodies at NTS. Streams (arroyos) in the region are ephemeral. Runoff results from snowmelt and from precipitation during storms that occur most commonly in winter and occasionally in fall and spring, as well as during localized thunderstorms that occur primarily in the summer. Much of the runoff quickly infiltrates into rock fractures or into the surface soils before being lost by evapotranspiration. Some is carried down alluvial fans in arroyos, and some drains onto playas where it may stand for weeks as a lake. Runoff in the eastern half of the site ultimately collects in the playas (Yucca and Frenchman Lakes) of Yucca Flat and Frenchman Flat, respectively (**Figure 4–25**). In the northeastern portion, runoff drains off the site and onto the Nellis Air Force Range Complex. In the western half and southernmost part of NTS, runoff is carried toward the Amargosa Desert (DOE 1996g). There are a number of springs on NTS, but seepage from springs travels only a short distance from the source before evaporating or infiltrating into the ground. In addition, there are a number of engineered waste disposal ponds and open reservoirs for industrial water on the site.

Intermittent streams within NTS are not classified, but are protected by the State of Nevada for specified uses in accordance with NAC 445A.199-445A.225. Surface water within NTS boundaries is not used. In fact, no public water supplies are drawn from springs in Amargosa Valley, which is located downgradient from NTS along the primary pathway for surface water flow. The closest surface water supply that is used for public consumption is Lake Mead, which supplies a large portion of the water demand of metropolitan Las Vegas. There are no NPDES permits for NTS because there are no wastewater discharges directly to onsite or offsite surface waters (DOE 2000j). However, discharges to sewage lagoons and ponds are regulated by the State of Nevada. Specifically, ten usable sewage treatment facilities on NTS operate under a state general permit (GNEV93001) issued by the Nevada Division of Environmental Protection. This permit was renewed for five years on December 7, 1999. NTS maintains compliance with required permits. Due to the reduced treatment efficiency noted in some sewage treatment lagoons, DOE plans to install septic systems in the affected areas which would be permitted under state operating permits (DOE 2000j).

The potential exists for sheet flow and channelized flow through arroyos to cause localized flooding throughout NTS. However, because of the size of NTS, no comprehensive floodplain analysis has been conducted to delineate the 100- and 500-year floodplains. Nevertheless, a rise in the surface elevation of any standing water on a playa creates a potential flood hazard. Playas in the Yucca Flat weapons test basin

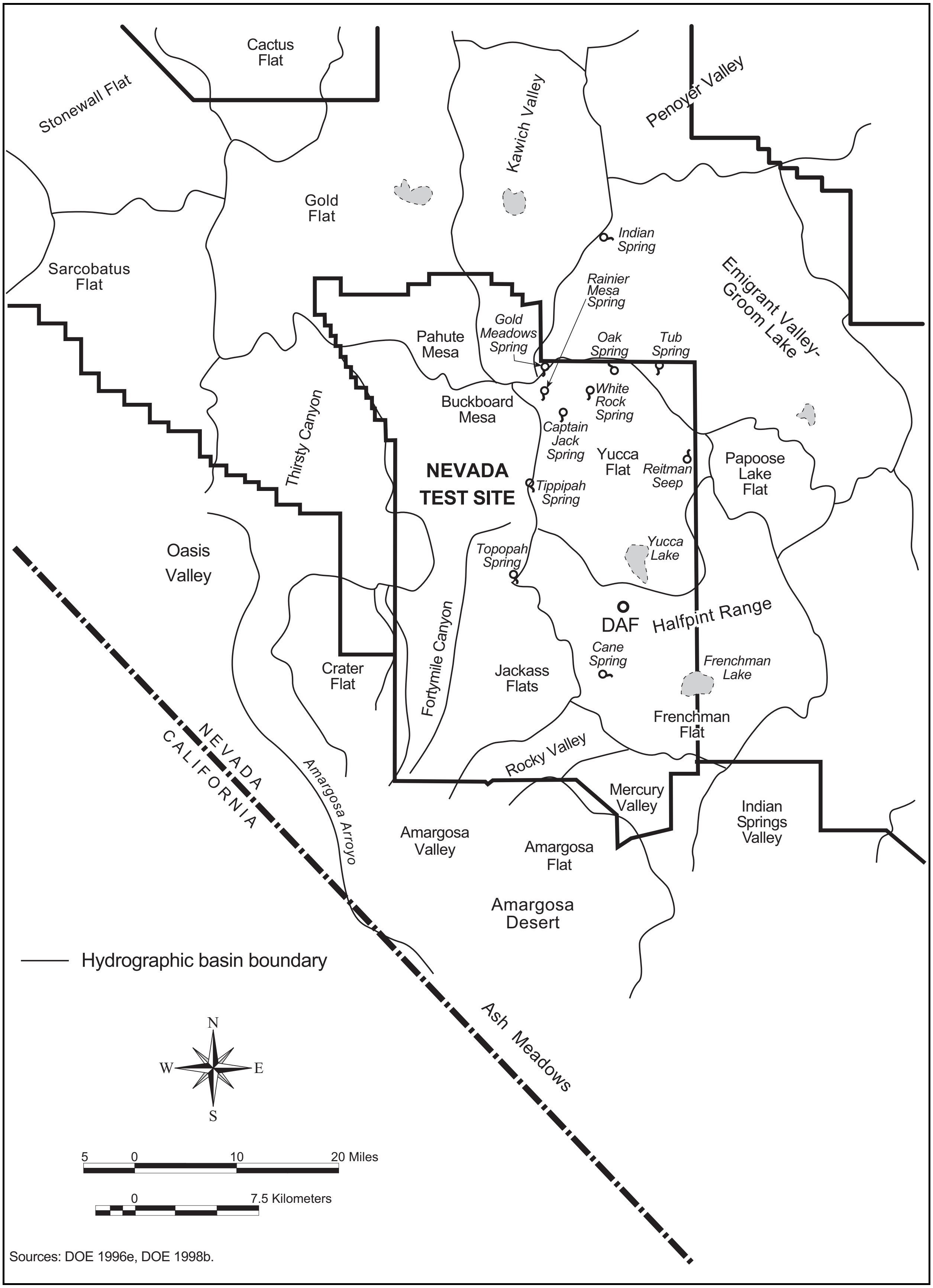


Figure 4–25 Surface Water Features at the Nevada Test Site

and Frenchman Flat in the northeastern and eastern parts of NTS, respectively, collect and dissipate runoff from their respective hydrographic basins. Several arroyos in the Yucca Flat weapons test basin pose a potential flood hazard to existing facilities as do arroyos on Frenchman Flat. Ground-surface disturbance and craters associated with underground nuclear tests have rerouted parts of natural drainage paths in areas of nuclear device testing. Some craters have captured nearby drainage, and headward erosion of drainage channels is occurring. However, this is considered to be negligible. In some areas of NTS, the natural drainage system has been all but obliterated by the craters. The western half and southernmost parts of NTS have arroyos that carry runoff beyond NTS boundaries during intense storms. Fortymile Canyon, the largest of these arroyos, originates on Pahute Mesa and intersects the Amargosa arroyo in the Amargosa Desert about 32 kilometers (20 miles) southwest of NTS. The Amargosa arroyo continues to Death Valley, California. Areas prone to flooding surround Fortymile Wash, a major tributary of Fortymile Canyon (Figure 4–24). Tonopah Wash, which runs southwesterly across Jackass Flats from Jackass Divide in the south-central part of NTS, is a major tributary to the Amargosa arroyo.

There are no named streams within the DAF area and no permanent, natural, surface water features near the area. An evaporation/percolation basin is located near the facility. Runoff from the site is conveyed via the natural topography east and southeast toward Frenchman Lake. This playa only retains standing water during the winter months. A storm water conveyance and diversion structure protects the facility and supporting structures from flooding and is designed for the probable maximum flood (DOE 1995d).

4.4.6.2 Groundwater

Groundwater beneath NTS exists within three groundwater subbasins of the Death Valley Basin flow system. This flow system encompasses about 41,000 square kilometers (16,000 square miles) of the Great Basin. In particular, the eastern half of NTS is located within the Ash Meadows Subbasin, and the western half of the site lies largely within the Alkali Flat Furnace Creek Ranch Subbasin. In addition, a small section of the northwest corner of the site is located within the Pahute Mesa Oasis Valley Subbasin (DOE 1999d) (**Figure 4–26**). The groundwater section boundaries delineated in Figure 4–26 roughly correspond to the hydrographic areas mapped in Figure 4–25. Hydrographic areas are mapped on the basis of topographic divides and are the geographic unit used by the State of Nevada for the purposes of water appropriation and management. NTS lies within at least part of 10 of these areas (i.e., Gold Flat, Buckboard Mesa, Kawich Valley, Emigrant Valley, Oasis Valley, Yucca Flat, Jackass Flats, Frenchman Flat, Rock Valley, and Mercury Valley) (DOE 1999d).

The hydrogeology of the NTS region is rather complex. Nevertheless, three principal hydrogeologic systems are recognized. The first is the valley-fill alluvium that mostly consists of gravel, sand, silt, and clay alluvium and playa lake deposits of Quaternary to Late Tertiary age (i.e., recent to about 5 million years old). These deposits comprise the valley-fill aquifer. Volcanic rocks including rhyolite lava flow and welded and nonwelded ash flow tuff deposits of mainly middle to late Tertiary age (i.e., about 5 to 24 million years old) characterize the second system. This system encompasses the lava flow and welded-tuff aquifers. The last major system consists of sedimentary rocks ranging in age from Permian/Pennsylvania to Cambrian (i.e., 245 to 570 million years old) that include the limestones and dolostones comprising the upper and lower carbonate aquifers. Within these systems, six major aquifers and four major aquitards in the region have been defined. Groundwater quality within aquifers at NTS not affected by nuclear testing is generally acceptable for drinking water and industrial and agricultural uses. All hydrologic units that supply drinking water to NTS are classified as Class II groundwater (i.e., those that are currently used or are potentially available for drinking water or other beneficial uses) (DOE 1998b). The lower carbonate aquifer primarily represents the regional aquifer and is composed of 4,000 to 5,000 meters (13,120 to 16,400 feet) of relatively thick, permeable limestones and dolostones with thinner, less permeable siltstones, shales, and quartzites. However, the lower carbonate aquifer is not present in all areas, and rarely is the entire thickness of the unit

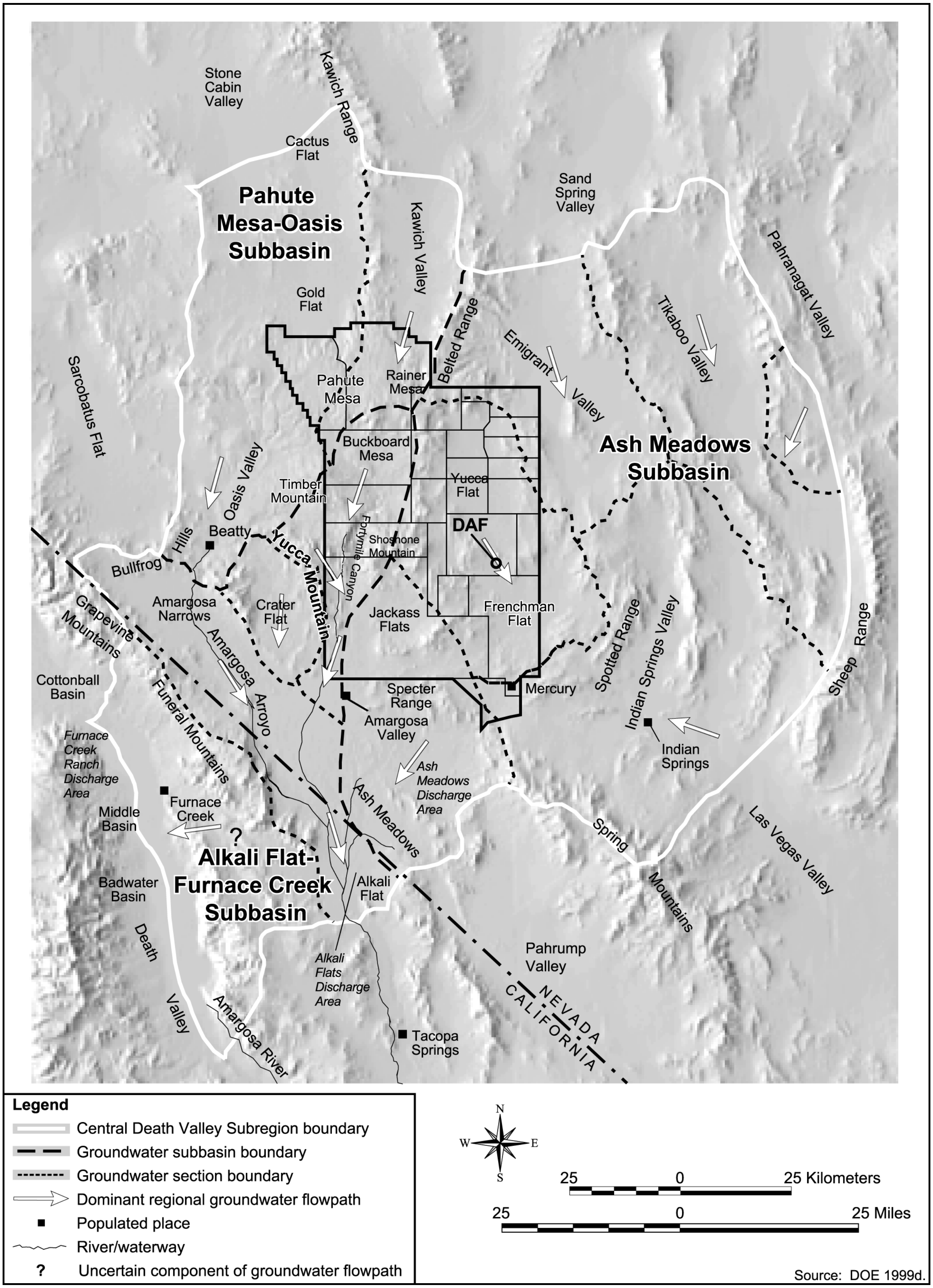


Figure 4–26 Groundwater Hydrologic Regions of the Nevada Test Site and Vicinity

present under NTS or adjacent areas. Generally, in the eastern half of the site, the water table occurs in the valley-fill alluvium and Tertiary volcanic rocks overlying the regional aquifer and predominantly in the volcanic aquifers across the western half of the site (DOE 2000j). Thinner sequences of these volcanic rocks overlie the upper carbonate aquifer and clastic confining units within some areas of the Yucca and Frenchman Flats.

The depth to groundwater in wells at NTS varies from about 79 meters (260 feet) below land surface in the extreme northwest part of the site and about 160 meters (525 feet) below land surface in portions of Frenchman Flat and the Yucca Flat weapons test basin to more than 610 meters (2,000 feet) under the upland portions of Pahute Mesa. Perched groundwater is known to occur in some parts of NTS, mainly in the volcanic rocks of the Pahute Mesa area. Groundwater flows generally south and southwest. The flow system extends from the water table to a depth that may exceed 1,494 meters (4,900 feet). The rates of flow are quite variable, with average flow rates over broad areas estimated to range from 2 to 201 meters per year (7 to 660 feet per year).

Recharge of the groundwater beneath NTS is primarily derived from underflow from basins upgradient from the site and from the infiltration of precipitation over upland areas on and upgradient from the site. Within the groundwater subbasins (Figure 4–26) of the Death Valley flow system, groundwater generally flows downgradient in a south-to-southwesterly direction with discharge occurring in the low-lying valleys as small springs or via evapotranspiration. These discharge locations are dictated by the presence of rocks of lower permeability and lower elevations. Two examples are the Ash Meadows and Alkali Flat discharge areas located south of NTS (Figure 4–26). The groundwater discharge from the Ash Meadows area is estimated at 21 million cubic meters (742 million cubic feet) per year. In contrast, groundwater discharge on NTS is more limited and occurs only as a few small springs from perched zones primarily located in the northern, upland areas of the site and from several wells.

Onsite water wells and select offsite wells are monitored in accordance with the Federal Safe Drinking Water Act and state regulations. Concurrently, DOE monitors onsite wells and select offsite wells for specific radionuclides. Approximately 30 monitoring wells and 10 springs are also sampled. Analytical results for all monitoring activities are published in the annual site environmental report (DOE 2000j).

The locations of 862 underground nuclear tests have been confirmed at NTS that correspond to areas of potential groundwater contamination (**Figure 4–27**). About one-third of these tests were at or below the water table and produced heavy metal and a wide range of radionuclide by-products. Detonations conducted near the water table have contaminated locally groundwater with over 60 radionuclides, with tritium being the most prevalent radionuclide. Additional information on activities being conducted under the site environmental restoration program to address contamination from underground nuclear testing is discussed in the annual site environmental report (DOE 2000j).

Drinking water at NTS is currently provided by 11 potable wells and is supplemented by bottled water in remote areas. Construction and fire-control water are supplied by two other wells in addition to the potable water supply wells. Springs and seeps are not used for water-supply purposes. DOE's water withdrawals have lowered water levels in the vicinity of water supply wells and have resulted in localized changes in groundwater flow direction. In general, the effects of pumping NTS water supply wells are concentrated within a distance of a few thousand feet of the operating wells. Water use is detailed in Section 4.4.2.4.

All water used at DAF in Area 6 is groundwater from four supply wells (C, C1, 4, and 4a). Wells 4 and 4a withdraw from volcanic aquifers at a depth of about 387 meters (1,270 feet), and wells C and C1 withdraw from the carbonate aquifers (upper and lower carbonate aquifers) from depths of 473 and 485 meters (1,552 and 1,591 meters), respectively. The depth to groundwater near the margins of Frenchman Flat in the

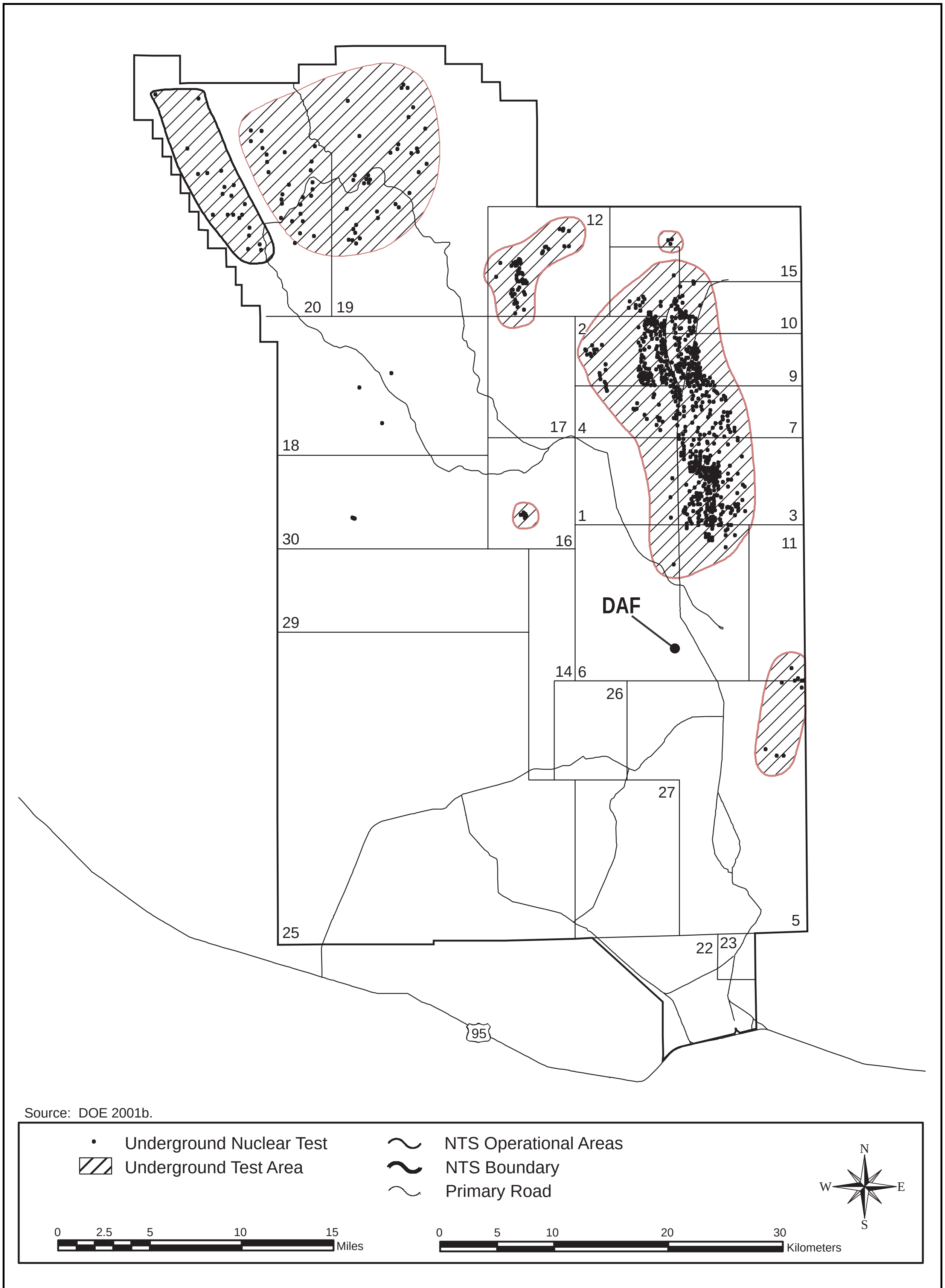


Figure 4–27 Areas of Potential Groundwater Contamination on NTS

vicinity of DAF is approximately 360 meters (1,180 feet) (DOE 1995d, DOE 2000j). The depth of the water table beneath DAF is approximately 280 meters (920 feet) (NTS 2001). The flow is generally to the southwest, but is locally variable.

4.4.7 Ecological Resources

4.4.7.1 Terrestrial Resources

NTS is located along the transition zone between the Mojave and Great Basin deserts. As a result, it has a diverse and complex mosaic of plant and animal communities representative of both deserts, as well as some communities common only in the transition zone between these deserts (**Figure 4–28**). This transition zone extends to the east and west far beyond the boundaries of NTS. Thus, the range of almost all species found on the site also extends beyond the site, and there are few rare or endemic species present.

Mojave Desert plant communities are found at elevations below approximately 1,219 meters (4,000 feet) in Jackass Flats, Rock and Mercury Valleys, and Frenchman Flat. Creosote bush is the visually dominant shrub, and it is associated with a variety of other shrubs, depending on soil type and elevation. Two plant communities are unique to the transition zone. The first, which occurs at elevations from 1,219 to 1,524 meters (4,000 to 5,000 feet), is dominated by blackbrush. The second occurs in the bottom of enclosed Frenchman and Yucca Flat weapons test basins, where trapped winter air is too cold for typical Mojave Desert plants. The most abundant shrubs in these areas include three species of wolfberry. Little or no vegetation grows on the playas in these basins. Plant communities typical of the Great Basin Desert occur at elevations generally above 1,524 meters (5,000 feet). Communities dominated by saltbush, rabbitbrush, sagebrush, and pinyon pine/sagebrush occur with increasing elevation. Over 700 plant taxa have been found at NTS.

Two hundred seventy-nine species of terrestrial vertebrates have been recorded at NTS, including 54 species of mammals, 190 species of birds, and 33 species of reptiles. Typical Mojave Desert species found at the site include kit fox, Merriam's kangaroo rat, desert tortoise, chuckwalla, western shovelnose snake, and sidewinder snake. Typical Great Basin Desert species include cliff chipmunk, Great Basin pocket mouse, mule deer, northern flicker, scrub jay, Brewer's sparrow, western fence lizard, and striped whipsnake. About 60 wild horses live on the northern part of NTS. Water holes, both natural and manmade, are important to many species of wildlife, including game animals such as pronghorn and mule deer. Hunting is not permitted anywhere on NTS. Raptors such as the turkey vulture and rough-legged hawk and carnivores such as the long-tailed weasel and bobcat are two ecologically important groups on the site. A variety of migratory birds have been found at NTS (DOE 1996g). Migratory birds are protected under the Migratory Bird Treaty Act.

Vegetative communities that are found within Area 6 include those of both the Mojave Desert and transition zone. DAF is located within habitat most like that of the Mojave Desert. Gentle slopes cut by shallow arroyos 1 to 3 meters (3 to 10 feet) deep with shallow soils characterize the area. Facilities associated with DAF include a paved access road, a water storage tank, a diversion ditch uphill of the buildings, and sewage evaporation ponds. Whereas cleared areas have removed habitat for most animals of the site, the sewage evaporation ponds have provided unlimited water to birds of the region. Baseline biological studies associated with the facility, conducted in 1993 and 1994, identified 117 species of plants, 11 mammals, 71 birds, and 16 reptiles in the vicinity of DAF (DOE 1995a, DOE 1995b). Dominant plants were the Joshua tree and creosote bush. Common animals included the Merrian's kangaroo rat, long-tailed pocket mouse, mourning dove, house finch, black-throated sparrow, zebra-tailed lizard, and side-blotched lizard.

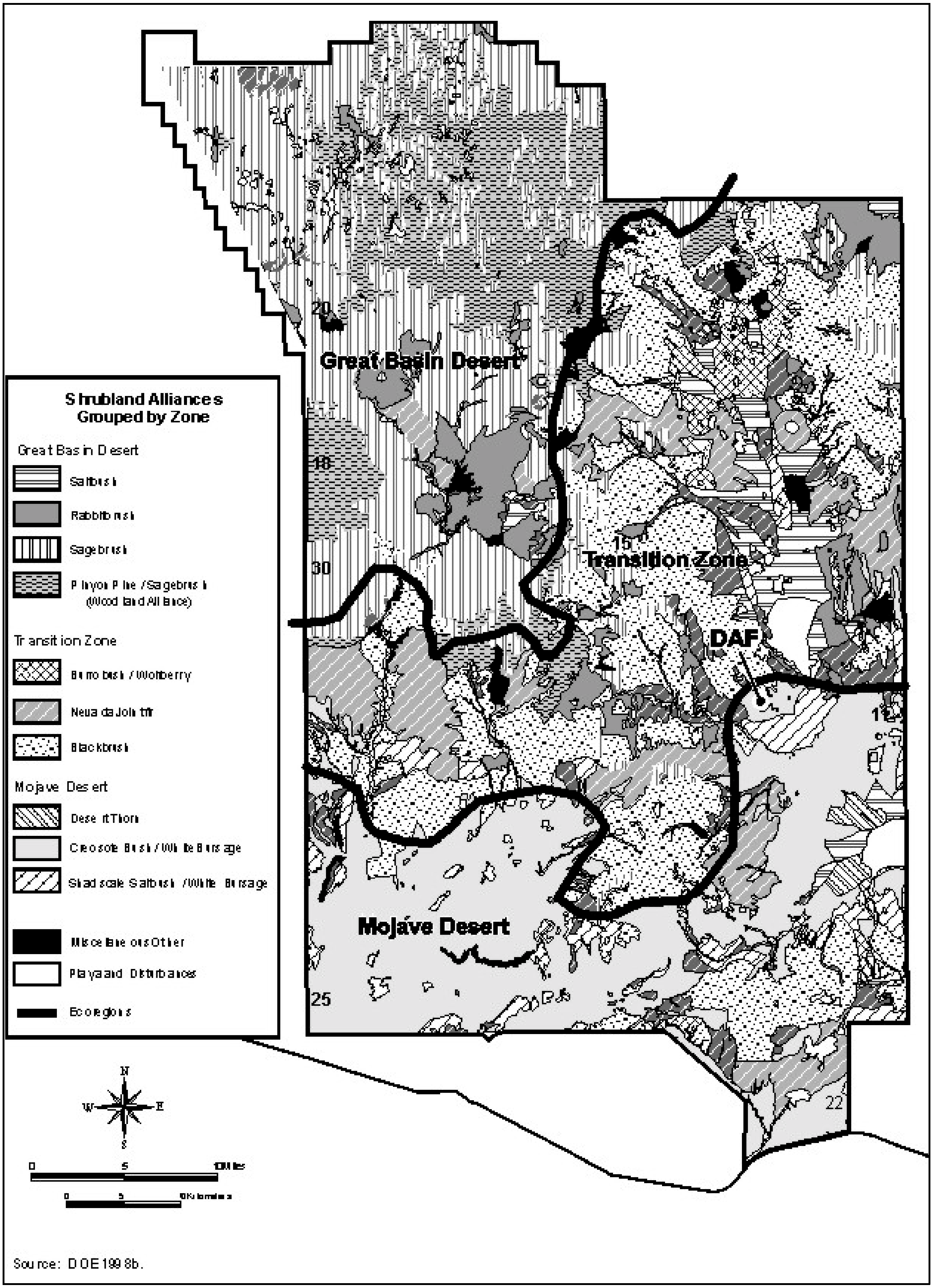


Figure 4–28 Vegetation Association at NTS

4.4.7.2 Wetlands

There are at least 20 springs and seeps found at NTS, most of which support wetland vegetation such as cattail, sedges, and rushes. It is likely that these would constitute wetlands as defined under Section 4.04 of the Clean Water Act. One newly identified wetland, an historic borrow pit that catches water in large enough quantities and for long enough periods of time to sustain wetland vegetation, has been identified (DOE 1999g).

There is one natural water body found within Area 6 (DOE 1998b). It is located about 6.5 kilometers (4 miles) north of DAF. There are no wetlands located within the vicinity of DAF.

4.4.7.3 Aquatic Resources

Known natural water sources on NTS consist of 24 springs and seeps, four tanks (natural rock depressions that catch and hold surface runoff), and one intermittent playa pond. Manmade impoundments on NTS, which are scattered throughout the eastern half of the site, support three introduced species of fish: bluegill, goldfish, and golden shiners. Eighty-one species of plants and 138 species of animals (not all of which are aquatic species) have been documented at or near aquatic sites on NTS (DOE 1999g).

There is one natural water body located in Area 6 about 6.5 kilometers (4 miles) north of DAF. However, sewage evaporation ponds are located at the DAF site (DOE 1995a). As noted above, these ponds are important to birds of the region.

4.4.7.4 Threatened and Endangered Species

There are three agencies that have authority to designate threatened, endangered, and sensitive species in Nevada. The agencies are the USFWS, the Nevada Division of Wildlife, and the U.S. Forest Service. The U.S. Forest Service lists species for special management consideration on lands under their jurisdiction and protects these species under the authority of the Endangered Species Act of 1973.

The only Federally threatened species found at NTS is the Mojave Desert population of the desert tortoise (**Table 4–40**). Desert tortoises are found throughout the southern half of the site. The abundance of tortoises at NTS is low to very low compared to other areas within the range of this species. NTS contains less than 1 percent of the total desert tortoise habitat of the Mojave Desert population (DOE 1998b).

Area 6 is located within that part of the Mojave Desert which makes up the northernmost territory for the desert tortoise. No other threatened or endangered species have been found in the area around the DAF. In addition, no critical habitat has been identified in the area.

4.4.8 Cultural and Paleontological Resources

The current knowledge of cultural resources at NTS is the result of over 20 years of surveys and data recovery, most conducted prior to specific NTS activities taking place. In addition to preactivity surveys and studies, in 1990 DOE entered into a Programmatic Agreement with the State Historic Preservation Office and the Advisory Council for Historic Preservation, which implemented the *Long-Range Study Plan for Negating Potential Adverse Effects to Historic Properties on Pahute and Rainier Mesas*. As a result of these programs, 4.7 percent of the site (16,386 hectares [40,491 acres]) has been surveyed for cultural resources. Due to the restricted status of NTS over the past 50 years, site cultural resources have not been subjected to illegal collecting and/or damage from indiscriminate land uses of public lands. Most archaeological sites are in good condition. Based on current knowledge, all areas of NTS have the potential to contain archaeological sites that are considered significant because they meet the eligibility criteria for the National Register of Historic Places.

Table 4–40 Listed Threatened and Endangered Species, Species of Concern, and Other Unique Species that Occur or May Occur at NTS

Species	*Federal Classification*	*State Classification*	*Occurrence at NTS*
Mammals			
Fringed-myotis	Special Concern	Unlisted	Occasional
Long-eared myotis	Special Concern	Unlisted	Occasional
Long-legged myotis	Special Concern	Unlisted	Occasional
Pale Townsend's big-eared bat	Special Concern	Unlisted	Occasional
Pygmy rabbit	Special Concern	Unlisted	Potential habitat
Spotted bat	Special Concern	Protected by State of Nevada	Occasional
Small-footed myotis	Special Concern	Special Concern	Potential habitat
Birds			
American peregrine falcon	Special Concern	Unlisted	Occasional
Black tern	Special Concern	Special Concern	Potential habitat
Ferruginous hawk	Special Concern	Unlisted	Rare transient
Gray flycatcher	Special Concern	Unlisted	Potential habitat
Least bittern	Special Concern	Special Concern	Potential habitat
Lucy's warbler	Special Concern	Unlisted	Potential habitat
Phainopepla	Special Concern	Special Concern	Potential habitat
Western burrowing owl	Special Concern	Protected by State of Nevada	Resident
White-faced ibis	Special Concern	Protected by State of Nevada	Migrant
Reptiles			
Bandelier Gila monster	Special Concern	Special Concern	Potential habitat
Chuckwalla	Special Concern	Unlisted	Resident
Desert tortoise	Threatened	Protected by State of Nevada	Resident
Plants			
Beatley mild vetch	Special Concern	Endangered	Potential habitat
Beatley phacelia	Special Concern	Unlisted	Potential habitat
Black woolypod	Special Concern	Unlisted	Potential habitat
Cane Spring evening primrose	Special Concern	Unlisted	Potential habitat
Clokey's egg-vetch	Special Concern	Unlisted	Potential habitat
Death Valley beard tongue	Special Concern	Unlisted	Potential habitat
Delicate rock daisy	Special Concern	Special Concern	Potential habitat
Eastwood milkweed	Special Concern	Special Concern	Potential habitat
Kingston bedstraw	Special Concern	Unlisted	Potential habitat
Pahute Mesa beardtongue	Special Concern	Unlisted	Potential habitat
Pahute Mesa green gentian	Special Concern	Unlisted	Potential habitat
Parish's phacelia	Special Concern	Unlisted	Potential habitat
Sanicle biscuitroot	Special Concern	Unlisted	Potential habitat
White bearpoppy	Special Concern	Unlisted	Potential habitat
White-margined beardtongue	Special Concern	Unlisted	Potential habitat

Source: DOE 1998b.

4.4.8.1 Prehistoric Resources

Prehistoric sites found on NTS include habitation sites with wood and brush structures, windbreaks, rock rings, and cleared areas; rock shelters; petroglyphs (rock art); hunting blinds; rock alignments; quarries; temporary camps; milling stations; roasting ovens or pits; water caches; and limited activity locations (DOE 1996g). Approximately 1,615 prehistoric sites have been identified on NTS, of which about one-half are eligible for listing on the National Register of Historic Places. Most of the known prehistoric cultural resources are concentrated in the northern third of the site on Pahute and Rainier Mesas, and in the southwestern portion of the site in the Forty-Mile Canyon and Cat Canyon areas (DOE 1998b).

By 1998, 42 archaeological reconnaissance surveys covering approximately 1,228 hectares (3,305 acres) had been conducted within the Frenchman Flat hydrologic basin. This is the area within which the DAF is located. Ninety-five prehistoric sites were recorded as a result of these surveys. Of these sites, 2 are temporary camps, 2 are extractive localities, 38 are processing localities, 52 are localities, and 1 is a residential base. More recently, 1,089 hectares (2,690 acres) in Frenchman Flat in Area 6 were surveyed for cultural resources. No sites eligible for the National Register of Historic Places were found (DOE 2000a).

4.4.8.2 Historic Resources

Historic site types on NTS include mines and prospects, trash dumps, settlements, campsites, ranches, homesteads, developed spring heads, roads, trails, and nuclear weapons developments sites. Sixty-five historic sites have been identified on NTS (DOE 1998b). One site, Sedan Crater, is listed on the National Register of Historic Places. Sedan Crater was created in 1962 as part of the Plowshare Program, whose aim was to identify peaceful uses for nuclear explosions. It is located in Yucca Flats. At least 600 buildings, structures, and objects dating to the Cold War era have been identified on NTS, but these have not been systematically recorded or evaluated for significance. Frenchman Flat and Yucca Flat are rich in significant structures of the atmospheric testing and Cold War eras, while the remaining portions of the site are less important with respect to historic sites from this period. One site considered eligible for listing is the Emigrant Trail, which traverses the southwest corner of NTS and was used by westward-bound pioneers of the nineteenth century. Additional historic sites may occur in unsurveyed portions of the site (DOE 1996g).

The DAF is located within the northern portion of Frenchman Flat. Four historic sites have been identified in the Frenchman Flat area. Two are of an unspecified historic nature and two are related to nuclear testing and research. The most recent archaeological survey of the Frenchman Flat area of Area 6, which covered 1,089 hectares (2,690 acres), did not identify any additional historic resources (DOE 2000a).

4.4.8.3 Native American Resources

The Consolidated Group of Tribes and Organizations has had a long-standing relationship with DOE since 1987. The group is comprised of 16 Tribes and 3 official Native American organizations, representing the Southern Paiutes, Western Shoshones, and Owens Valley Paiutes. Each of these internal groups substantiated cultural and historic ties to NTS and the surrounding areas. The primary focus of the Consolidated Group of Tribes and Organizations has been the protection of traditional cultural resources. The organization has identified several sites at NTS that are important to Native American people, including storied rocks, rock shelters, wooden lodges, rock rings, springs, and certain archaeological sites. In addition, 107 plant and more than 20 animal species resident on NTS have been identified by Native American elders as part of their traditional resources. Due to the restricted access status of NTS for over 50 years, most of the site has not been impacted by grazing, mining, offroad vehicle travel, or other public uses. This has contributed significantly to the preservation of many cultural and biological resources that are important to Native Americans (DOE 1998b).

The Consolidated Group of Tribes and Organizations has stated that Frenchman Flat, where DAF is located, contains a wide variety of plants, animals, and archaeological sites of cultural importance to Native American people. A total of 20 plant species was identified at two plant study locations within the west-central portion of this area.

4.4.8.4 Paleontological Resources

Alluvium-filled valleys surrounded by ranges composed of Precambrian and Paleozoic sedimentary rocks and Tertiary volcanic tuffs and lavas characterize the surface geology of NTS. Although the Precambrian sedimentary deposits contain no fossils or only a few poorly preserved fossils, the Paleozoic marine limestones are moderately to abundantly fossiliferous. Marine fossils found in the same Paleozoic formation on Nellis Air Force Range, adjacent to NTS to the north, include trilobites, conodonts, ostracods, solitary and colonial corals, brachiopods, cephalopods, algae, gastropods, and archaic fish. These fossils, however, are relatively common and have low research potential. Tertiary volcanic deposits are not expected to contain fossils (DOE 1996g).

Late Pleistocene terrestrial vertebrate fossils could be expected in Quaternary deposits. The possibility of finding mammoth, horse, camel, and bison remains might be expected because such fossils have been found at Tule Springs, 56 kilometers (35 miles) from the southern edge of NTS, as well as in Nye Canyon. Fossils found at Tule Springs include bison, deer, a small donkey-like horse, camel, Columbia mammoth, ground sloth, giant jaguar, bobcat, coyote, muskrat, and a variety of rabbits, rodents, and birds. Although no known fossil localities have been recorded to date on NTS, Quaternary deposits with paleontological materials may occur on the site (DOE 1996g).

As noted above, no known pleistocene fossil localities have been recorded to date on NTS, including the DAF area. Also, no fossils were discovered during construction of DAF. However, since paleontological surveys of the site have not been conducted, the possibility exists that Ice Age fossils could be found in Quaternary alluvium within the area.

4.4.9 Socioeconomics

Statistics for population, housing, community services, and local transportation are presented for the region of influence, a two-county area in Nevada (**Figure 4–29**) in which 97 percent of all NTS employees reside (**Table 4–41**). Within Clark County, most NTS employees reside in the Las Vegas area.

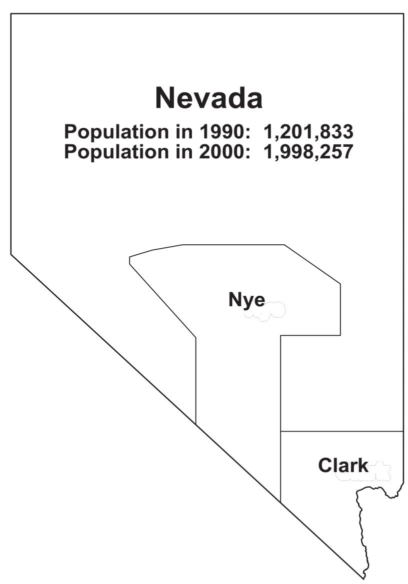


Figure 4–29 Counties in the NTS Region of Influence

4.4.9.1 Regional Economic Characteristics

Between 1990 and 1999, the civilian labor force in the NTS region of influence increased 57.3 percent to the 1999 level of 664,889. In 1999, the annual unemployment average in the two-county area was 4.4 percent, which was the same as the annual unemployment average for Nevada (4.4 percent) (DOL 2000).

In 1998, service activities represented the largest sector of employment in the region of influence (45.1 percent). This was followed by retail trade (20.4 percent), and government

(10.4 percent). The totals for these employment sectors in Nevada were 42.4 percent, 20.5 percent, and 11.8 percent, respectively (NDETR 1999).

Table 4–41 Distribution of Employees by Place of Residence in the NTS Region of Influence in 1994

County	*Number of Employees*	*Total Site Employment (percent)*
Clark	Not available	90
Nye	Not available	7
Region of influence total	Not available	97

Source: DOE 1996e.

4.4.9.2 Demographic Characteristics

The 2000 demographic profile of the region of influence population is included in **Table 4–42**. Between 1990 and 2000, the region of influence population increased by 85.5 percent. The 2000 population was 1,408,250 people, of whom about 97.6 percent lived in Clark County. Persons self-designated as minority individuals comprised a 39.2 percent of the total population.

Income information for the NTS region of influence is included in **Table 4–43.** In 1997, the median household income in Clark County ($39,486) was higher than the Nye County median income ($36,580) and the Nevada state average of $39,280. Both counties had a larger percentage of persons living below the poverty lined compared to the state average.

Table 4–42 Demographic Profile of the Population in the NTS Region of Influence

	Clark County	*Nye County*	*Region of Influence*
Population			
2000 Population	1,375,765	32,485	1,408,250
1990 Population	741,368	17,781	759,149
Percent Change from 1990 to 2000	85.6	82.7	85.5
Race (2000) (Percent of Total Population)			
White	71.6	89.6	72.0
Black or African American	9.1	1.2	8.9
American Indian and Alaska Native	0.8	2.0	0.8
Asian	5.3	0.8	5.2
Native Hawaiian and Other Pacific Islander	0.5	0.3	0.5
Some other race	8.6	3.0	8.5
Two or more races	4.2	3.1	4.2
Percent Minority	39.8	15.3	39.2
Ethnicity (2000)			
Hispanic or Latino	301,143	2,713	304,856
Percent of Total Population	22.3	8.4	21.6

Source: DOC 2001.

Table 4–43 Income Information for the NTS Region of Influence

	Clark County	*Nye*	*Nevada*
Median Household Income 1997 ($)	39,486	36,580	39,280
Percent of Persons Below Poverty Line (1997)	11.1	12.7	10.7

Source: DOC 2000.

4.4.9.3 Housing and Community Services

Table 4–44 lists the total number of occupied housing units and vacancy rates in the NTS region of influence. In 1990, the region of influence contained 325,261 housing units, of which 293,689 were occupied. The median values of owner-occupied units were $93,300 in Clark County and $70,800 in Nye County. The vacancy rate in Clark County was 9.5 percent, and the vacancy rate in Nye County was 17.5 percent (DOC 1998).

Community services include public education and health care (i.e., hospitals, hospital beds, and doctors). In 1998, student enrollment in the region of influence totaled 209,042, with a student-to-teacher ratio of 20:1 (Department of Education 2000). Community health services and facilities are concentrated in Clark County (Gaquin and DeBrandt 2000).

Table 4–44 Housing and Community Services in the NTS Region of Influence

	Clark County	*Nye County*	*Region of Influence*
Housing (1990) [a]			
Total units	317,188	8,073	325,261
Occupied housing units	287,025	6,664	293,689
Vacant units	30,163	1,409	31,572
Vacancy rate (percent)	9.5	17.5	9.7
Median value ($)	93,300	70,800	–
Public Education (1998) [b]			
Total enrollment	203,777	5,265	209,042
Student-to-teacher ratio	20:1	15.6:1	20:1
Community Health Care (1998) [c]			
Hospitals	8	1	9
Hospital beds per 1,000 persons	1.9	1.6	1.9
Physicians per 1,000 persons	1.7	0.5	1.7

[a] DOC 1998.
[b] Department of Education 2000.
[c] Gaquin and DeBrandt 2000.

4.4.9.4 Local Transportation

The main access to NTS is Mercury Highway, which originates at U.S. Highway 95, 105 kilometers (65 miles) northwest of Las Vegas, Nevada, and accesses the main gate in Mercury (see Figure 4–21). U.S. Highway 95 is the most frequented direct access to NTS and is used by over 95 percent of the employees working on site. It is the closest and most direct route to the site for hauling materials and waste, whether hauled directly by trucks or by rail. Another entrance located 8 kilometers (5 miles) to the west of Mercury is a turnoff to Jackass Flats Road; however, this entrance is presently barricaded. NTS has a restricted access into Area 25 from U.S. Highway 95 at Lathrop Wells Road, which is located about 32 kilometers (20 miles) west of Mercury. A seldom-used fourth entrance is located in the northeast corner of the site and can be reached from State Route 375. This route requires crossing the Nellis Air Force Range Complex. Other existing roadways, although unpaved, could provide entrance or exit routes in case of an emergency. Access to NTS is restricted, and guard stations are located at all entrances, as well as throughout the site. Background traffic on key roads in the vicinity of the site has grown rapidly in the last 10 years. For example, average annual growth ranging from 2 to 5 percent has been experienced on U.S. Highway 95, while less than 2 percent growth is common elsewhere on rural highways. While background traffic has increased in Nevada, traffic volumes at the Mercury interchange have decreased by approximately 2 percent per year during the last 10 years because of reductions in the NTS workforce.

Commuter buses provide daily passenger service to NTS from Las Vegas and Pahrump by way of U.S. Highway 95. The number of buses entering the site varies daily depending on the onsite activities in progress. Currently, there are 54 buses serving Las Vegas and 5 buses serving Pahrump. The commuter bus service provides dedicated routes to the forward areas, and paved parking areas for the buses are located at the support facilities within Areas 6, 23 (Mercury), and 25. Limited bus parking is also available at other NTS support facilities. Parking for government and private commuter vehicles is available at most buildings at the site.

The closest rail line to NTS is the Union Pacific line, which passes through Las Vegas approximately 80 kilometers (50 miles) east of Mercury. This line connects Los Angeles with Salt Lake City. There is no direct railway link to the site. Commercial air service to and from the area is available through McCarran International Airport, which is located in Las Vegas, 120 kilometers (75 miles) southeast of NTS. Aside from three small airports in the region, air transport service is also possible through two U.S. Air Force bases in the area: Nellis Air Force Base in North Las Vegas and the Indian Springs Auxiliary Airfield. Two serviceable airstrips are also located on NTS (Desert Rock Airport in Area 22 and Yucca Lake airstrip in Area 6) in addition to 10 helipads.

4.4.10 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. As discussed in Appendix E, minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multiracial. Persons whose incomes are below the Federal poverty threshold are designated low-income.

DAF is located at latitude 36° 53’37.824" north, longitude 116° 2’54.794" west. No Indian reservations lie within or partially within the region of potential radiological impacts centered on the DAF.

Three counties in Nevada are partially included in the potentially affected area (**Figure 4–30**): Clark, Lincoln, and Nye. In addition, Inyo County, California, is partially contained in the region of potential radiological impacts. **Table 4–45** provides the racial and Hispanic composition for these counties using data obtained from the decennial census conducted in 2000. In the year 2000, approximately 4 of 10 county residents identified themselves as a member of a minority group. Hispanics or Latinos and Blacks or African Americans comprised approximately three-quarters of the resident minority population.

Figure 4–31 compares the growth in minority populations in the potentially affected counties between 1990 and 2000. As discussed in Section E.5.1 of Appendix E, data concerning race and Hispanic origin from the 2000 Census cannot be directly compared with that from the 1990 Census because the racial categories used in the two enumerations were different. Bearing this change in mind, the minority populations in potentially affected counties increased from approximately 24 percent to 39 percent in the decade from 1990 to 2000. During that decade, Nevada’s population increase was the largest among all of the states in the U.S. The Hispanic or Latino population more than tripled, and the Asian population of potentially affected counties nearly tripled during the past decade. Over 70 percent of the increase in minority populations occurred in the Las Vegas metropolitan area of Clark County. For comparison, minorities composed approximately one-quarter of the total population of the United States in 1990 and nearly one-third of the total population in 2000.

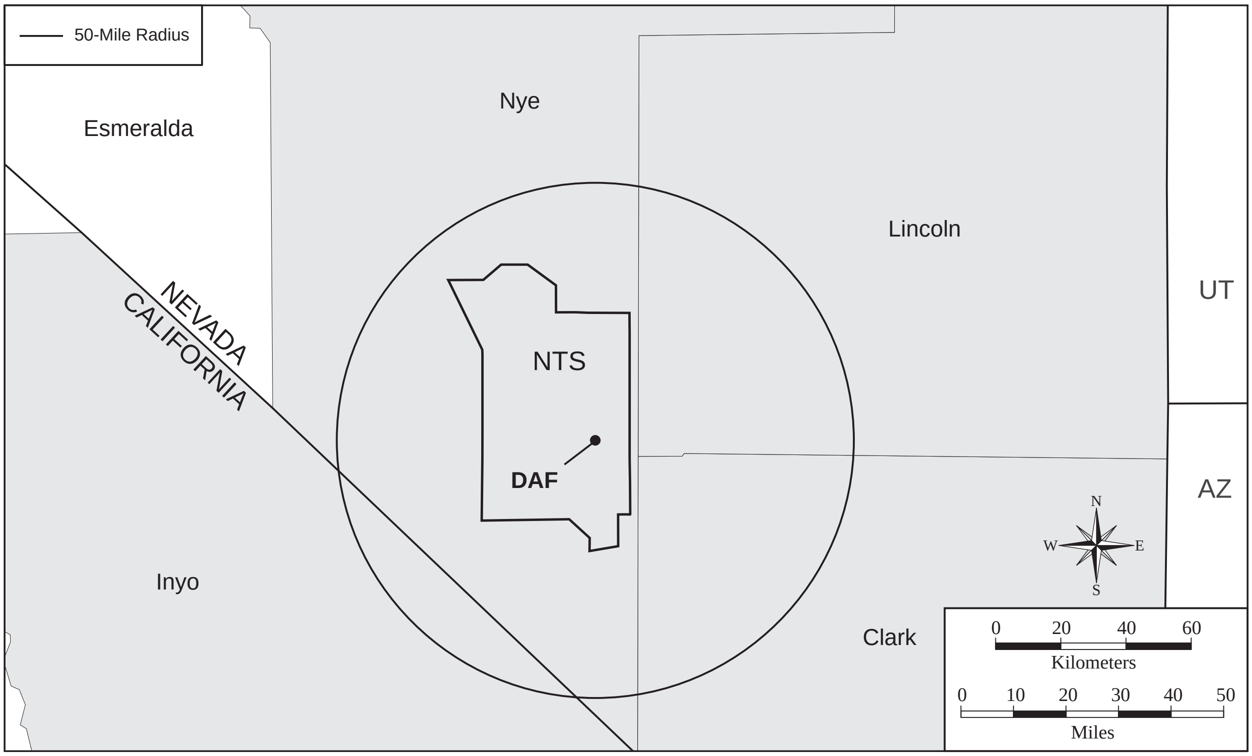


Figure 4–30 Potentially Affected Counties Surrounding DAF at NTS

Table 4–45 Populations in Potentially Affected Counties Surrounding DAF in 2000

Population Group	*Population*	*Percentage of Total*
Minority	554,986	38.8
Hispanic	307,334	21.5
Black/African American	121,865	8.5
American Indian/Alaska Native	10,092	0.7
Asian	71,639	5.0
Native Hawaiian/Pacific Islander	5,980	0.4
Two or More Races	38,076	2.7
Some Other Race	2,133	0.1
White	873,241	61.1
Total	1,430,360	100.0

Source: DOC 2001.

The percentage of low-income population at risk in potentially affected counties surrounding DAF in 1990 was approximately 14 percent. In 1990, nearly 13 percent of the total population of the continental United States reported incomes less than the poverty threshold. In terms of percentages, minority populations in potentially impacted counties are relatively large in comparison with the national percentage, largely due to the population explosion in the Las Vegas metropolitan area during the last decade. The percentage low-income population at risk in 1990 is commensurate with the corresponding national percentage. Complete census data with block group resolution for minority and low-income populations obtained from the decennial census of 2000 are scheduled for publication in 2002.

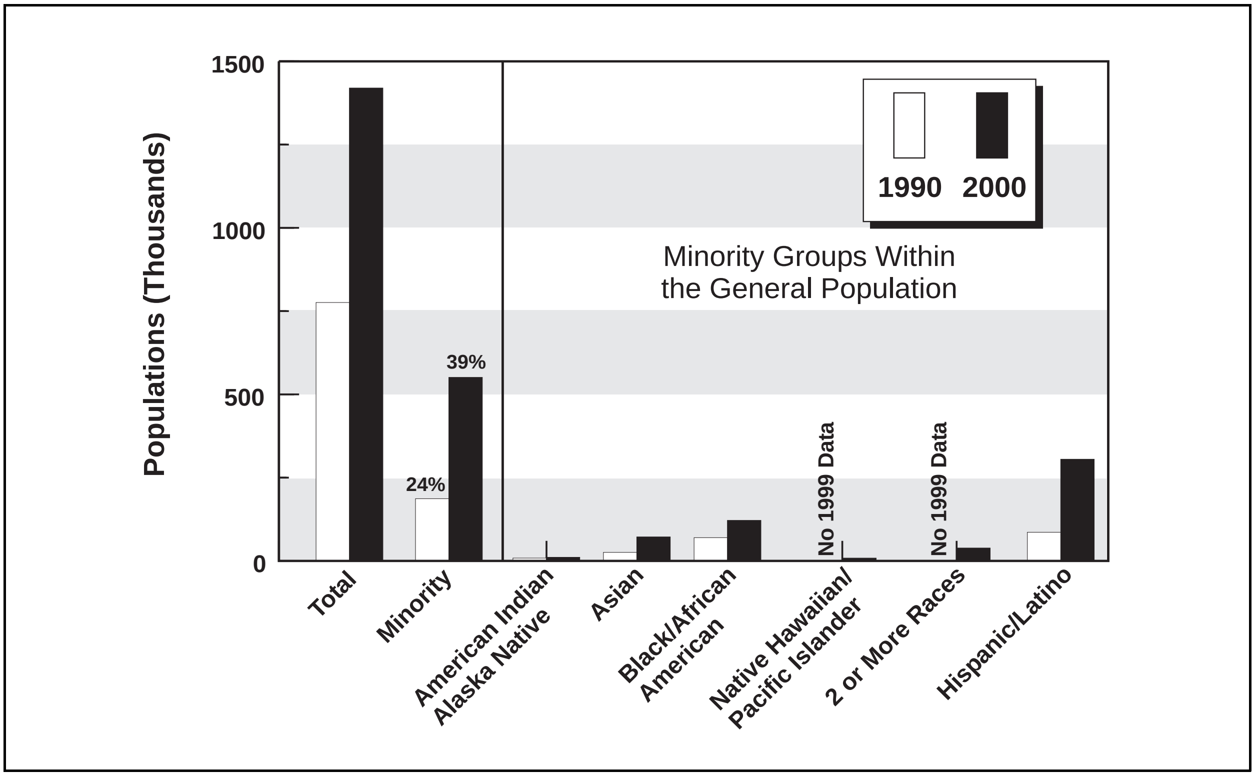


Figure 4–31 Comparison of Populations in Potentially Affected Counties Surrounding DAF in 1990 and 2000

4.4.11 Existing Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health resulting from acute and chronic exposures to ionizing radiation and hazardous chemicals.

4.4.11.1 Radiation Exposure and Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of NTS are shown in **Table 4–46**. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to NTS operations.

Releases of radionuclides to the environment from NTS operations provide another source of radiation exposure to individuals in the vicinity of NTS. Types and quantities of radionuclides released from NTS operations in 1999 are listed in the *Nevada Test Site Annual Site Environmental Report for Calendar Year 1999* (DOE 2000j). The releases are summarized in Section 4.4.3.2 of this EIS. The doses to the public resulting from these releases are presented in **Table 4–47**. These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those of background radiation.

Table 4–46 Sources of Radiation Exposure to Individuals in the NTS Vicinity Unrelated to NTS Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural Background Radiation	
Total external (cosmic and terrestrial) [a]	74
Internal terrestrial and global cosmogenic [b]	40
Radon in homes (inhaled)	200 [b, c]
Other Background Radiation [b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	less than 1
Air travel	1
Consumer and industrial products	10
Total	379

[a] Derived from information on cosmic and terrestrial radiation given in EPA 1981.
[b] NCRP 1987.
[c] This is an average for the United States.

Table 4–47 Radiation Doses to the Public From Normal NTS Operations in 1998 (total effective dose equivalent)

Members of the Public	*Atmospheric Releases*		*Liquid Releases*		*Total*	
	Standard [a]	*Actual*	*Standard* [a]	*Actual*	*Standard* [a]	*Actual*
Maximally exposed offsite individual (millirem)	10	0.63 [b]	4	0	100	0.63
Population within 80 kilometers (50 miles) (person-rem) [b]	None	0.38	None	0	100	0.38
Average individual within 80 kilometers (50 miles) (millirem) [c]	None	0.01	None	0	None	0.01

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that Order, the 10-millirem per year limit from airborne emissions is required by the Clean Air Act (40 CFR 61) and the 4-millirem per year limit is required by the Safe Drinking Water Act (40 CFR 141). The total dose of 100 millirem per year is the limit from all pathways combined. The 100-person-rem value for the population is given in the proposed 10 CFR 834, *Radiation Protection of the Public and Environment; Proposed Rule,* published in 58 FR 16268. If the potential total dose exceeds the 100 person-rem value, the contractor operating the facility would be required to notify DOE.
[b] Includes the air, milk, and wildlife dose pathways.
[c] Based on a population of 36,517 in 1999.
[d] Obtained by dividing the population dose by the number of people living within 80 kilometers (50 miles) of the site.
Source: DOE 2000j.

Using a risk estimator of 1 latent cancer death per 2,000 person-rem to the public (see Appendix B), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from NTS operations in 1999 is estimated to be 3.2×10^{-7}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with one year of NTS operations is about 3 in 10 million (it takes several to many years from the time of radiation exposure for a cancer to manifest itself).

According to the same risk estimator, 1.9×10^{-4} excess fatal cancers are projected in the population living within 80 kilometers (50 miles) of NTS from normal operations in 1999. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 1999 from all causes in the population living within 80 kilometers (50 miles) of NTS was 73. This expected number of fatal cancers is much higher than the 1.9×10^{-4} fatal cancers estimated from NTS operations in 1998.

NTS workers receive the same dose as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at NTS from operations in 1998 are presented in **Table 4–48**. These doses fall within the radiological regulatory limits of 10 CFR 835. According to a risk estimator of 1 latent fatal cancer per 2,500 person-rem among workers (see Appendix B), the number of projected fatal cancers among NTS workers from normal operations in 1998 is 4.0×10^{-4}. The risk estimator for workers is lower than the estimator for the public because of the absence from the work force of the more radiosensitive infant and child age groups.

Table 4–48 Radiation Doses to Workers From Normal NTS Operations in 1998 (total effective dose equivalent)

Occupational Personnel	*Onsite Releases and Direct Radiation*	
	Standard [a]	*Actual*
Average radiation worker (millirem)	None [b]	77
Total workers [c] (person-rem)	None	1

[a] The radiological limit for an individual worker is 5,000 millirem per year (10 CFR 835). However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 millirem per year (DOE 1999e); the site must make reasonable attempts to maintain individual worker doses below this level.

[b] No standard is specified for an average radiation worker; however, the maximum dose that this worker may receive is limited to that given in footnote a.

[c] There were 13 workers with measurable doses in 1998.

Sources: DOE 1998c.

External radiation doses have been measured in the vicinity of the NTS DAF site that may contain radiological sources for comparison with offsite natural background radiation levels. Measurements taken in 1999 showed an average onsite dose in the vicinity of the DAF site of 91 millirem, compared to an offsite dose of 101 millirem (DOE 2000j).

External concentrations of plutonium in air are measured in the vicinity of DAF. The concentrations of plutonium-239/240 in the vicinity of DAF in 1999 was 2.1×10^{-17} curies per cubic meter. This value is about three times higher than that measured at offsite control locations. Finally, concentrations in air of gross alpha and beta radiation in the vicinity of DAF in 1999 were 2.2×10^{-15} curies per cubic meter and 2.2×10^{-14} curies per cubic meter, respectively. These alpha and beta radiation concentrations are about the same as those measured at offsite locations (DOE 2000j).

4.4.11.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at NTS via inhalation of air containing hazardous chemicals released to the atmosphere by NTS operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Baseline air emission concentrations for air pollutants and their applicable standards are presented in Section 4.4.3.1. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are compared with applicable guidelines and regulations.

Chemical exposure pathways to NTS workers during normal operation may include inhaling the workplace atmosphere, drinking NTS potable water, and other possible contacts with hazardous materials associated with work assignments. Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. NTS workers are also protected by adherence to OSHA and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at NTS are expected to be substantially better than required by standards.

4.4.11.3 Health Effects Studies

Several epidemiological studies have been conducted to investigate possible adverse health effects of low-level radioactive fallout on residents of Nevada and Utah. These studies have been summarized in the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management (SSM PEIS)* (DOE 1996f). A mortality study of Utah children under 15 years old investigated the relationship between childhood leukemia and radioactive fallout and found a significant excess of leukemia among children who died during the high fallout period (between 1951 and 1958) compared to those who died during the low fallout periods (between 1944 and 1950 and between 1959 and 1975). A follow-up study found that bone doses of southern Utah residents were too low to account for the excess leukemia deaths.

A nonstatistically significant excess of thyroid neoplasm was reported among children living near the nuclear testing sites (Utah/Nevada) compared to a group living in Arizona.

An excess number of leukemia cases were observed among men who participated in military maneuvers in August 1957. No excess in “total cancers” was observed, but four cases of polycythemia vera were reported where 0.2 were expected. For a more detailed description of the studies and the findings, refer to Appendix Section E.4.9 of the *SSM PEIS* (DOE 1996f).

Occupational health studies on NTS workers are being conducted; however, no completed studies on the health of current or past NTS workers are available (DOE and HHS 2000). In one study, accessible information is being reviewed to determine whether former NTS workers might develop health problems due to their employment at the site. The review is focused on construction workers in underground and excavation work and re-entry workers who were employed there from 1951-1992. About 15,000 workers were identified for the cohort study. Exposure information and health data are being collected, and former workers are being contacted. A determination of which workers might possibly be at significant risk for health problems will be made. Those workers will be offered an opportunity to participate in a free medical screening program.

4.4.11.4 Accident History

Nuclear testing began at NTS in 1951. There were some 100 atmospheric nuclear explosions before the Limited Test Ban Treaty was implemented in 1973. Since then, all nuclear tests have been conducted underground.

Since 1970, there have been 126 nuclear tests that released approximately 54,000 curies of radioactivity to the atmosphere. Of this amount, 11,500 curies were accidentally released due to containment failure (massive releases or seeps) and late-time seeps. (Seeps are small releases after a test when gases diffuse through pore spaces in the overlying rock.) The remaining 42,500 curies were operational releases. From the perspective of human health risk, if the same person were standing at the boundary of NTS in the area of maximum concentration of radioactivity for every test since 1970, that person's total exposure would be equivalent to 32 extra minutes of normal background exposure, or the equivalent of one-thousandth of a single chest x-ray (OTA 1989).

4.4.11.5 Emergency Preparedness

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and is maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response. The NTS Emergency Preparedness Plan is designed to minimize or mitigate the impact of any emergency upon the health and safety of employees and the public. The plan integrates all emergency planning into a single entity to minimize overlap and duplication and to ensure proper responses to emergencies not covered by a plan or directive. The manager of the Nevada Operations Office has the responsibility to manage, counter, and recover from an emergency occurring at NTS.

The NTS Emergency Preparedness Plan provides for identification and notification of personnel regarding any emergency that may develop during operational and nonoperational hours. The Nevada Operations Office receives warnings, weather advisories, and any other communications that could provide advance warning of a possible emergency. The plan is based upon current Nevada Operations Office vulnerability assessments, resources, and capabilities regarding emergency preparedness.

DOE has also specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at Hanford in May 1997.

4.4.12 Waste Management

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies, and in compliance with all applicable Federal and state statutes and DOE orders.

4.4.12.1 Waste Inventories and Activities

NTS manages the following types of waste: transuranic, mixed transuranics, low-level radioactive, mixed low-level radioactive, hazardous, and nonhazardous. Because there is no transuranic or mixed transuranic waste associated with TA-18 operations, these waste types are not discussed in this EIS. Waste generation rates and the inventory of stored waste from activities at NTS are provided in **Table 4–49**. The NTS waste management capabilities are summarized in **Table 4–50**.

Table 4–49 Waste Generation Rates and Inventories at NTS

Waste Type	*Generation Rate (cubic meters per year)*	*Inventory (cubic meters)*
Low-level radioactive	178	Not available
Mixed low-level radioactive	0	Not available
Hazardous	34.6	Not applicable [a]
Nonhazardous (liquid and solid)	7,170	Not applicable [a]

[a] Generally, hazardous and nonhazardous wastes are not held in long-term storage.
Source: DOE 1996f.

Table 4–50 Waste Management Facilities at NTS

Facility	*Capacity*	*Status*	*Applicable Waste Type*			
			Low-Level Radioactive Waste	*Mixed Low-Level Radioactive Waste*	*Hazardous*	*Non-hazardous*
Treatment Facility						
Explosive Ordnance Disposal Unit (kilograms per year)	1,873	Online			X [a]	
Storage Facility						
Transuranic Waste Storage Pad (cubic meters)	1,150	Online		X		
Hazardous Waste Storage Unit (liters)	61,625	Online			X	
Disposal Facility						
Areas 3 and 5 Radioactive Waste Management Site (cubic meters)	500,000	Online	X			
Area 5 Pit 3 Mixed Waste Disposal Unit (cubic meters)	118,908	Online		X		
Area 6 Hydrocarbon Disposal Site (cubic meters)	42,000	Online				X
Area 9 U-10c Solid Waste Disposal Site (cubic meters)	990,000	Online				X
Area 23 Solid Waste Disposal Site (cubic meters)	450,000	Online				X

[a] Treatment of waste explosives, including damaged or expired conventional explosives, by detonation.
Sources: DOE 1996e, DOE 1996g.

Other than reporting requirements, there is no formal CERCLA program at NTS. The Federal Facilities Agreement and Consent Order with the state may preclude NTS from being placed on the National Priority List. More of a RCRA approach in remediating environmental problems will be taken under the Federal Facilities Agreement and Consent Order (DOE 1999g). More information on regulatory requirements for waste disposal is provided in Chapter 6.

4.4.12.2 Low-Level Radioactive Waste

NTS has a formal storage facility for NTS-generated low-level radioactive waste. This facility is located in the Area 5 Radioactive Waste Management Site. NTS-generated waste is stored at this facility while characterization and certification activities are being completed prior to disposal.

NTS currently operates the Area 3 and 5 Radioactive Waste Management Sites for the disposal of low-level radioactive waste generated at NTS and at offsite DOE and DOD facilities. Low-level radioactive waste is accepted for disposal from generators that have received approval from DOE Headquarters and DOE Nevada Operations Office (DOE 1999g).

The Area 5 Radioactive Waste Management Site uses pits and trenches for shallow land burial of standard-packaged low-level waste. Included in this category of low-level waste is classified waste. Classified waste is low-level radioactive waste that is "classified" because of the physical shape or specific composition of the material contained in the waste. Classification creates a need for the use of separate disposal units which are controlled with additional security measures. Area 3 uses subsidence craters generated during underground nuclear weapons testing for disposal of bulk low-level radioactive waste. Waste disposed of at Area 3 tends to have a lower activity concentration than waste disposed of at Area 5 because bulk waste tends to be generated during environmental restoration projects (DOE 1999g).

4.4.12.3 Mixed Low-Level Radioactive Waste

On January 5, 1994, the State of Nevada and NNSA Nevada Operations Office entered into a Mutual Consent Agreement that allowed mixed low-level radioactive wastes generated at NTS to be moved into storage at the Area 5 Transuranic Waste Storage Pad. This was amended in June 1994 to include mixed low-level radioactive waste generated in Nevada via environmental restoration work. Waste at this facility will continue to be held in storage until a final determination of the proper treatment and disposal technology is established by the EPA. A Federal Facilities Agreement and Consent Order was signed, effective March 27, 1996, requiring compliance with a site treatment plan, which was also finalized in March 1996. Compliance with the Federal Facilities Agreement and Consent Order exempts NTS from potential enforcement action resulting from the mixed waste storage prohibition under RCRA (DOE 1999g).

A single disposal unit, Pit 3 in Radioactive Waste Management Site Area 5, has interim status as a mixed waste disposal unit for NTS-generated wastes that meet the RCRA land disposal restrictions. Mixed low-level radioactive waste is stored on the Transuranic Waste Storage Pad until characterization is complete. If the waste meets or has been treated to meet the land disposal restrictions requirements, it may be disposed of in Pit 3 (DOE 1999g).

4.4.12.4 Hazardous Waste

Hazardous wastes result from ongoing operations that utilize solvents, lubricants, fuel, lead, metals, motor oil, and acids. Hazardous wastes are accumulated at satellite areas, stored at the Area 5 RCRA-permitted Hazardous Waste Storage Unit for up to one year and shipped offsite by truck using Department of Transportation-approved transporters to a commercial RCRA-permitted facility. The Area 11 Explosive Ordnance Disposal Unit is a thermal treatment unit where explosive wastes are detonated or treated.

4.4.12.5 Nonhazardous Waste

Solid waste landfills located in Areas 6, 9, and 23 are in use for the disposal of solid nonhazardous wastes. The Area 6 Hydrocarbon Disposal Site accepts hydrocarbon-burdened soil and debris. The Area 9 U-10c Solid Waste Disposal Site is a construction and demolition landfill. The Area 23 Solid Waste Disposal Site receives all types of nonhazardous solid waste with non pathogenic hospital waste, dead animals, and asbestos-containing materials buried in separate cells that are identified by concrete markers. Liquid nonhazardous wastes are disposed of in septic tanks, sumps, or ponds (DOE 1996g).

4.4.12.6 Waste Minimization

The NNSA Nevada Operations Office has an active waste minimization and pollution prevention program to reduce the total amount of waste generated and disposed of at NTS. This is accomplished by eliminating waste through source reduction or material substitution; by recycling potential waste materials that cannot be minimized or eliminated; and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. The Nevada Operations Office published its first Waste Minimization Plan in 1991, which defined specific goals, methodologies, responsibilities, and achievements of various programs and organizations. The achievements and progress are updated at least annually. Implementing pollution prevention projects reduced the total amount of waste generated at NTS in 1999 by approximately 1,223 cubic meters (1,600 cubic yards). Examples of pollution prevention projects completed in 1999 at NTS include: reduction of sanitary waste by approximately 716 metric tons (789 tons) by selling ferrous, nonferrous, and light steel scrap metals for recycling; and reduction of sanitary waste by less than 1 metric ton (1.1 tons) by collecting and redistributing unneeded copier machine supplies within the Nevada Operations Office and the Nevada Environmental Protection Agency, and returning the remaining supplies to the vendor for credit (DOE 2000i).

4.4.12.7 Waste Management PEIS Records of Decision

The *Waste Management PEIS* Records of Decision affecting NTS are shown in **Table 4–51**. Decisions on the various waste types were announced in a series of Records of Decision that have been published as a result of analyses documented in the *Waste Management PEIS* (DOE 1997a). The hazardous waste Record of Decision was published on August 5, 1998 (63 FR 41810), and the low-level radioactive and mixed low-level radioactive waste Record of Decision was published on February 18, 2000 (65 FR 10061). The hazardous waste Record of Decision states that most DOE sites will continue using offsite facilities to treat and dispose of major portions of nonwastewater hazardous waste, except the Oak Ridge Reservation and the Savannah River Site, which will continue treating some of their own nonwastewater hazardous waste on site in existing facilities where this is economically feasible. The low-level radioactive waste and mixed low-level radioactive waste Record of Decision states that, for the management of low-level radioactive waste, minimal treatment will be performed at all sites, and disposal will continue on site to the extent practicable at INEEL, LANL, the Oak Ridge Reservation, and the Savannah River Site. In addition, Hanford and on site NTS will be available to all DOE sites for low-level radioactive waste disposal. Mixed low-level radioactive waste will be treated at Hanford, INEEL, the Oak Ridge Reservation, and the Savannah River Site, and will be disposed of at Hanford and NTS. More detailed information concerning DOE's decisions for the future configuration of waste management facilities at NTS is presented in the hazardous waste and low-level radioactive waste and mixed low-level radioactive waste Records of Decision.

4.5 ANL-W

ANL-W is located within the boundaries of INEEL. Because of this, the general site description presented in this section is that of INEEL. INEEL is located on approximately 230,700 hectares (570,000 acres) in southeastern Idaho and is 55 kilometers (34 miles) west of Idaho Falls; 61 kilometers (38 miles) northwest of Blackfoot; and 35 kilometers (22 miles) east of Arco (see **Figure 4–32**). INEEL is owned by the Federal Government and administered, managed, and controlled by DOE. It is primarily within Butte County, but portions of the site are also in Bingham, Jefferson, Bonneville, and Clark Counties. The site is roughly equidistant from Salt Lake City, Utah, and Boise, Idaho (DOE 2000k).

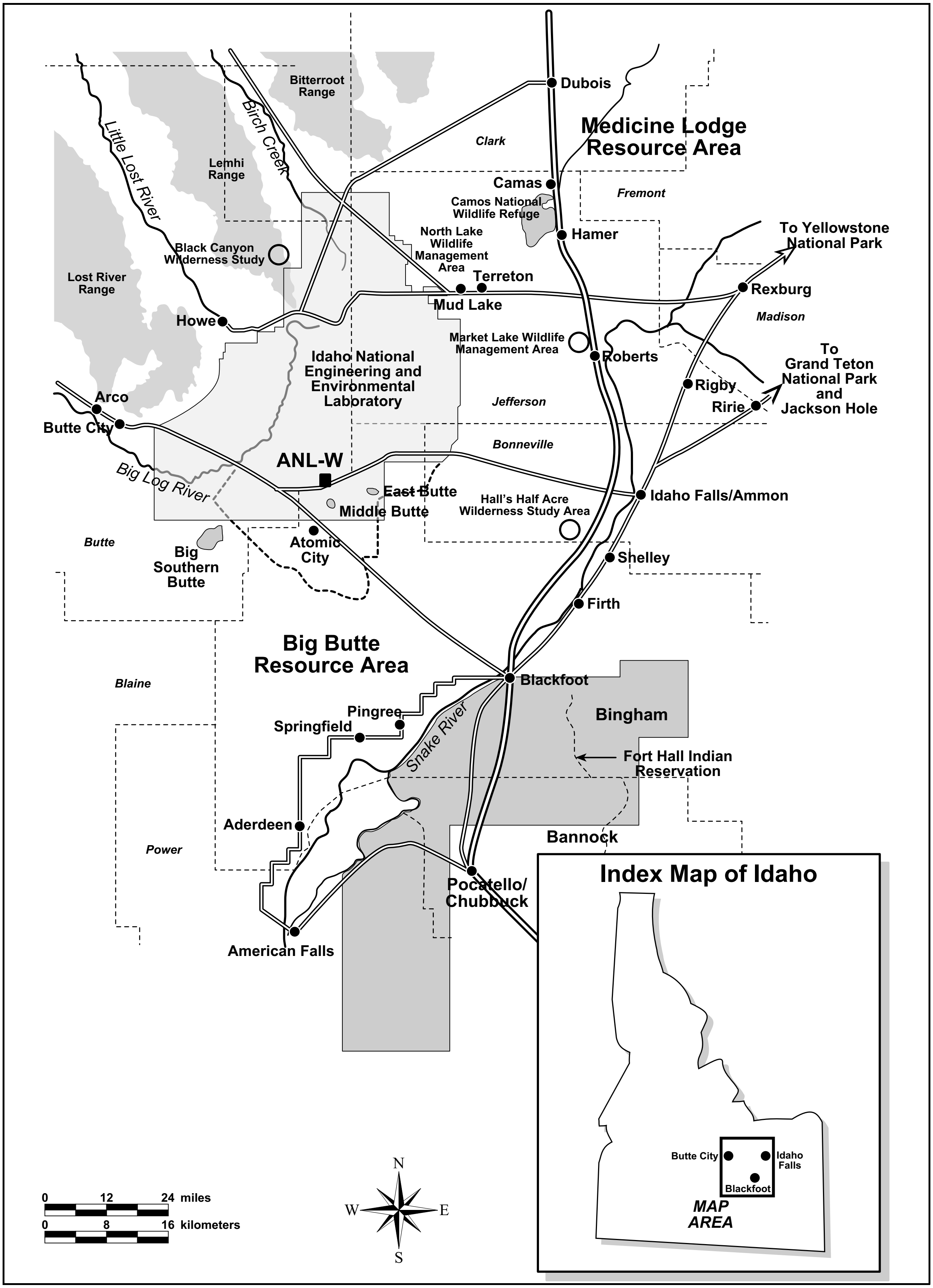


Figure 4–32 Idaho National Engineering and Environmental Laboratory Vicinity

Table 4–51 Waste Management PEIS Records of Decision Affecting NTS

Waste Type	Preferred Action
Low-level radioactive	DOE has decided to continue to treat and dispose of NTS low-level radioactive waste on site. In addition, NTS is available to all DOE sites for low-level radioactive waste disposal. [a]
Mixed low-level radioactive	DOE has decided to regionalize treatment of mixed low-level radioactive waste at the Hanford Site, INEEL, the Oak Ridge Reservation, and the Savannah River Site. NTS will continue to dispose of its own mixed low-level radioactive waste on site and will receive and dispose of mixed low-level radioactive waste generated and shipped by other sites, consistent with permit conditions and other applicable requirements. [a]
Hazardous	DOE has decided to continue to use commercial facilities for treatment of NTS nonwastewater hazardous waste. [b]

[a] From the Record of Decision for low-level radioactive and mixed low-level radioactive waste (65 FR 10061).
[b] From the Record of Decision for hazardous waste (63 FR 41810).
Source: 65 FR 10061, 63 FR 41810.

There are 450 buildings and 2,000 support structures at INEEL, with more than 279,000 square meters (3,000,000 square feet) of floor space in varying conditions of utility. INEEL has approximately 25,100 square meters (270,000 square feet) of covered warehouse space and an additional 18,600 square meters (200,000 square feet) of fenced yard space. The total area of the various machine shops is 3,035 square meters (32,665 square feet) (DOE 2000k).

Fifty-two research and test reactors have been used at INEEL over the years to test reactor systems, fuel and target design, and overall safety. In addition to nuclear research reactors, other INEEL facilities are operated to support reactor operations. These facilities include high- and low-level radioactive waste processing and storage sites; hot cells; analytical laboratories; machine shops; and laundry, railroad, and administrative facilities. Other activities include management of one of DOE's largest storage sites for low-level radioactive waste and transuranic waste (DOE 2000k).

ANL-W is located in the southeastern portion of INEEL, about 61 kilometers (38 miles) west of the city of Idaho Falls. The site is designated as a testing center for advanced technologies associated with nuclear power systems. The area has 52 major buildings, including reactor buildings, laboratories, warehouses, technical and administrative support buildings, and craft shops that comprise 55,700 square meters (600,000 square feet) of floor space (DOE 1997c). Five nuclear test reactors have operated on the site, although the only one currently active is a small reactor used for radiography examination of experiments, waste containers, and spent nuclear fuel. Principal facilities located at ANL-W include the Fuel Manufacturing Facility, Transient Reactor Test Facility, Fuel Conditioning Facility, Hot Fuel Examination Facility, Zero Power Physics Reactor, and Experimental Breeder Reactor II. The following descriptions of the affected environment at INEEL and ANL-W are based all or in part on information provided in the *Idaho High-Level Waste and Facility Disposition EIS* (DOE 1999j), the *EIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (DOE 2000e), and the *NI PEIS* (DOE 2000k) which are incorporated by reference.

4.5.1 Land Resources

4.5.1.1 Land Use

The Federal Government, the State of Idaho, and various private parties own lands surrounding INEEL. Regional land uses include grazing, wildlife management, mineral and energy production, recreation, and crop production. Small communities and towns near the INEEL boundaries include Mud Lake and Terraton to the east; Arco, Butte City, and Howe to the west; and Atomic City to the south. Two National Natural Landmarks border INEEL: Big Southern Butte (2.4 kilometers [1.5 miles] south) and Hell's Half Acre (2.6 kilometers [1.6 miles] southeast). A portion of Hell's Half Acre National Natural Landmark is designated as a Wilderness Study Area. The Black Canyon Wilderness Study Area is adjacent to INEEL, and the Craters of the Moon Wilderness Area is located about 20 kilometers (12 miles) southwest of INEEL's western boundary. On November 9, 2000, President Clinton signed a Presidential Proclamation that added 267,500 hectares (661,000 acres) to the 21,850-hectare (54,000-acre) monument.

Land use categories at INEEL include facility operations, grazing, general open space, and infrastructure such as roads. Approximately 60 percent of the site is used for cattle and sheep grazing. Generalized land uses at INEEL and the surrounding vicinity are shown in **Figure 4–33**. Facility operations include industrial and support operations associated with energy research and waste management activities. Land is also used for recreation and environmental research associated with the designation of INEEL as a National Environmental Research Park. Much of INEEL is open space that has not been designated for specific use. Some of this space serves as a buffer zone between INEEL facilities and other land uses. Recently, 29,950 hectares (74,000 acres) of open space in the north-central portion of the site were designated as the INEEL Sagebrush Steppe Ecosystem Reserve. This area represents one of the last sagebrush steppe ecosystems in the United States and provides a home for a number of rare and sensitive species of plants and animals. Approximately 2 percent of the total INEEL site area (4,600 hectares [11,400 acres]) is used for facilities and operations. Facilities are sited within a central core area of about 93,100 hectares (230,000 acres) (Figure 4–33). Public access to most facilities is restricted. DOE land use plans and policies applicable to INEEL are discussed in the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE 1995c).

All county plans and policies encourage development adjacent to previously developed areas to minimize the need for infrastructure improvements and to avoid urban sprawl. Because INEEL is remote from most developed areas, its lands and adjacent areas are not likely to experience residential and commercial development, and no new development is planned near the site. Recreational and agricultural uses, however, are expected to increase in the surrounding area in response to greater demand for recreational areas and the conversion of rangeland to cropland.

The Fort Bridger Treaty of July 3, 1868, secured the Fort Hall Reservation as the permanent homeland of the Shoshone-Bannock Peoples. According to the treaty, tribal members reserved rights to hunting, fishing, and gathering on surrounding unoccupied lands of the United States. While INEEL is considered occupied land, it was recognized that certain areas on the INEEL site have significant cultural and religious significance to the tribes. A 1994 Memorandum of Agreement with the Shoshone-Bannock Tribes provides tribal members access to the Middle Butte to perform sacred or religious ceremonies or other educational or cultural activities.

The total land area at ANL-W is 328 hectares (810 acres); however, site facilities are principally situated within about 20 hectares (50 acres), or 6 percent of the site. ANL-W is located 7 kilometers (4.3 miles) northwest of the nearest site boundary. Land within the fenced portion of the site has been heavily disturbed, with buildings, parking lots, and roadways occupying most areas and is no natural habitat present. The Fuel Manufacturing Facility is located within the main fenced portion of the site, while the Transient Reactor Test Facility is located about 1.2 kilometers (0.75 miles) to the northeast (Figure 3–13). Land within the site will continue to be used for nuclear and nonnuclear scientific and engineering experiments for DOE, private industry, and academia (DOE 1997c).

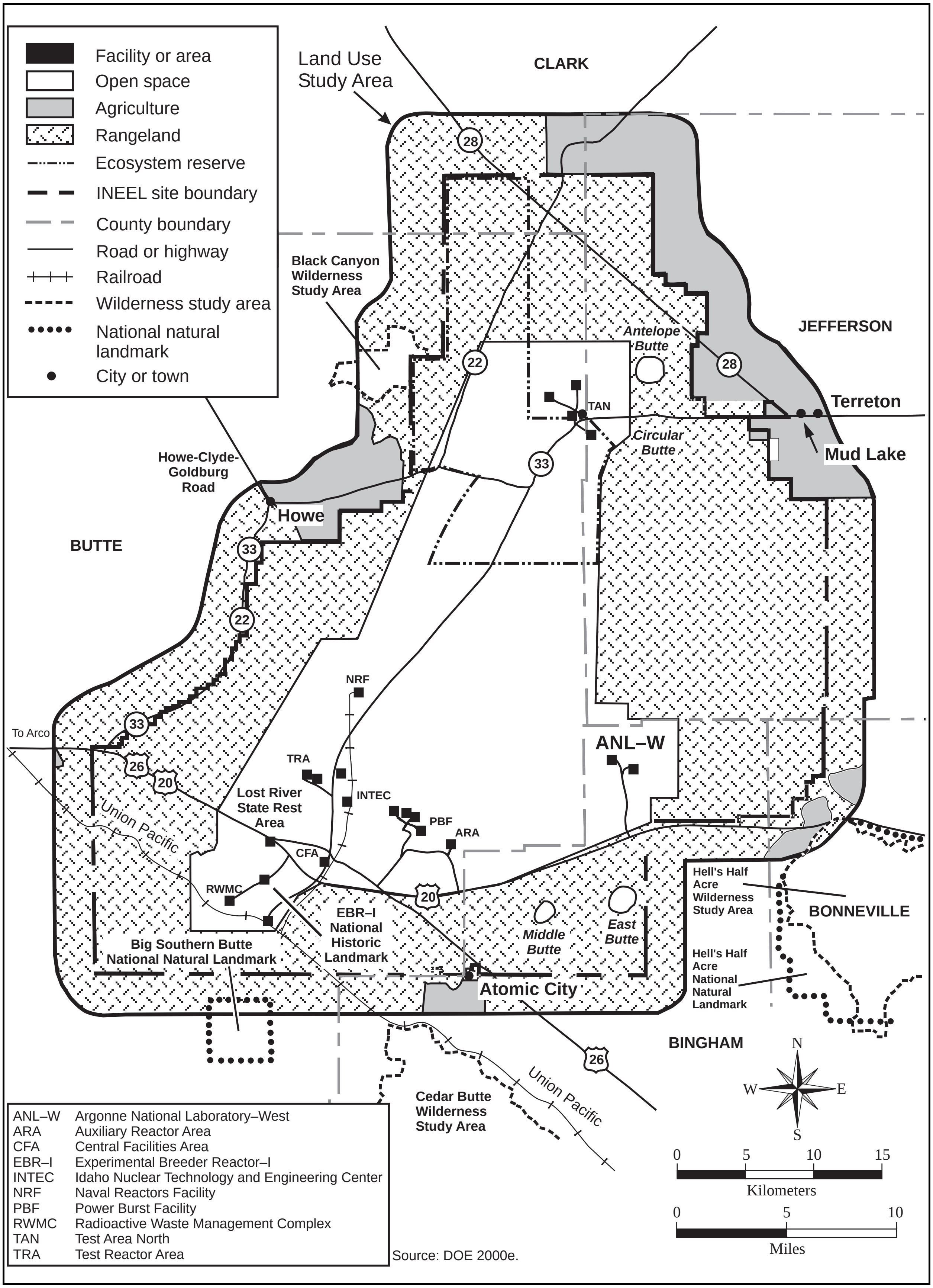


Figure 4–33 Land Use at INEEL and Vicinity

4.5.1.2 Visual Resources

The Bitterroot, Lemhi, and Lost River mountain ranges border INEEL on the north and west. Volcanic buttes near the southern boundary of INEEL can be seen from most locations on the site. INEEL generally consists of open desert land predominantly covered by big sagebrush and grasslands. Pasture and farmland border much of the site. Ten facility areas are on the INEEL site. Although INEEL has a comprehensive facility and land use plan (DOE 1997c), no specific visual resource standards have been established. INEEL facilities have the appearance of low-density commercial/industrial complexes widely dispersed throughout the site. Structure heights generally range from 3 to 30 meters (10 to 100 feet); a few stacks and towers reach 76 meters (250 feet). Although many INEEL facilities are visible from highways, most facilities are more than 0.8 kilometers (0.5 miles) from public roads. The operational areas are well defined at night by the security lights.

Lands adjacent to INEEL are under Bureau of Land Management jurisdiction and have a Visual Resource Contrast Class II rating. Lands within the INEEL site have a Visual Resource Contrast rating of Class II and III. Management activities within these classes may be seen, but should not dominate the review. The Black Canyon Wilderness Study Area adjacent to INEEL is under consideration by Bureau of Land Management for Wilderness Area designation, approval of which would result in an upgrade of its Visual Resource Contrast rating from Class II to Class I. The Hell's Half Acre Wilderness Study Area is 2.6 kilometers (1.6 miles) southeast of INEEL's eastern boundary. This area, famous for its lava flow and hiking trails, is managed by the Bureau of Land Management. The Craters of the Moon Wilderness Area is about 20 kilometers (12 miles) southwest of INEEL's western boundary.

Developed areas within ANL-W are consistent with a Class IV Visual Resource Contrast rating in which management activities dominate the view and are the focus of viewer attention. The tallest structure at ANL-W is the Fuel Conditioning Facility stack, which is 61 meters (200 feet) in height. The site is visible from Highway 20. Facilities that stand out from the highway include the Transient Reactor Test Facility, Hot Fuel Examination Facility, the Experimental Breeder Reactor-II containment shell, and the Zero Power Physics Reactor. Natural features of visual interest within a 40-kilometer (25-mile) radius of ANL-W include the East Butte at 9 kilometers (5.6 miles), Middle Butte at 11 kilometers (6.8 miles), Hell's Half Acre National Natural Landmark and Hell's Half Acre Wilderness Study Area at 15 kilometers (9.3 miles), Big Lost River at 19 kilometers (11.8 miles), and Big Southern Butte National Natural Landmark at 30 kilometers (18.6 miles).

4.5.2 Site Infrastructure

Site infrastructure characteristics are identified in **Table 4–52**.

4.5.2.1 Ground Transportation

The road network at INEEL provides for onsite transportation; railroads are used for deliveries of large volumes of coal and oversized structural components. Commercial shipments are transported by truck; some bulk materials are transported by train; and waste is transported by truck and train. About 140 kilometers (87 miles) of paved surface have been developed out of the 445 kilometers (277 miles) of roads on the site, including 29 kilometers (18 miles) of service roads that are closed to the public (Table 4–52). Most of the roads are adequate for the current level of normal transportation activity and could handle increased traffic volume.

Table 4–52 INEEL Sitewide Infrastructure Characteristics

Resource	*Site Usage*	*Site Capacity*
Transportation		
Roads (kilometers)	445 [a]	Not applicable
Railroads (kilometers)	48	Not applicable
Electricity		
Energy consumption (megawatt-hours per year)	221,772	394,200
Peak load (megawatts)	39	124
Fuel		
Natural gas (cubic meters per year)	0	Not applicable
Liquid fuels (liters per year)	5,820,000	16,000,000 [b]
Coal (metric tons per year)	11,340	11,340 [b]
Water (liters per year)	4,829,000,000 [c]	43,000,000,000 [d]

a Includes paved and unpaved roads.
b Low supplies can be replenished by truck or rail and, therefore, are essentially not limited.
c 1998 usage (DOE 2000k).
d Water right allocation.
Source: DOE 2000e.

The Union Pacific Railroad's Blackfoot-to-Arco Branch crosses the southern portion of INEEL and provides rail service to the site. This branch connects with a DOE spur line at Scoville Siding, then links with developed areas within INEEL. There are 48 kilometers (30 miles) of railroad track at INEEL. Rail shipments to and from INEEL usually are limited to bulk commodities, spent nuclear fuel, and radioactive waste. Local and linking regional transportation systems including roadways are detailed in Section 4.5.9.4.

4.5.2.2 Electricity

Commercial electric power is supplied to INEEL through two feeders from the Antelope substation to the Federally owned Scoville substation, which supplies electric power directly to the site's electric power distribution system. Electric power supplied by Idaho Power Company is generated by hydroelectric generators along the Snake River in southern Idaho and by the Bridger and Valmy coal-fired thermal electric generation plants in southwestern Wyoming and northern Nevada.

Site electrical availability is about 394,200 megawatt-hours per year. In 1997, INEEL used 221,772 megawatt-hours of electricity. The 1997 peak load usage was about 39 megawatts; the peak load capacity for INEEL is 124 megawatts (Table 4–52). Current electrical usage at ANL-W is 28,700 megawatt-hours per year.

4.5.2.3 Fuel

Fuel consumed at INEEL includes several types of liquid petroleum fuel, coal, and propane gas. All fuel is transported to the site for use and storage. Fuel storage is provided for each facility, and the inventories are restocked as necessary. The current site usage of fuel oil is about 5.8 million liters (1.5 million gallons) per year. The current site usage of coal is about 11,340 metric tons (12,500 tons) per year (Table 4–52). If additional coal or fuel oil were needed during the year, it could be shipped to the site.

4.5.2.4 Water

The Snake River Plain aquifer is the source of all water used at INEEL (see Section 4.5.6.2). The water is provided by a system of about 30 wells, together with pumps and storage tanks. That system is administered by DOE, which holds the Federal Reserved Water Right of 43 billion liters (11.4 billion gallons) per year for the site. INEEL site-wide groundwater production in 1998 was about 4.83 billion liters (1.28 billion gallons) (see Table 4–52). In 1998, ANL-W withdrew some 187.6 million liters (49.6 million gallons) from its two production wells (EBR II #1 and EBR II #2).

4.5.3 Air Quality

The climate at INEEL and the surrounding region is characterized as that of a semiarid steppe. The average annual temperature at INEEL is 5.6 °C (42 °F); average monthly temperatures range from a minimum of -8.8 °C (16.1°F) in January to a maximum of 20 °C (68 °F) in July. The average annual precipitation is 22 centimeters (8.7 inches). Prevailing winds at INEEL are southwest or northeast. The annual average wind speed is 3.4 meters per second (7.5 miles per hour).

4.5.3.1 Nonradiological Releases

INEEL is within the Eastern Idaho Intrastate Air Quality Control Region (#61). None of the areas within INEEL and its surrounding counties are designated as nonattainment areas with respect to the NAAQS for criteria air pollutants (40 CFR 81.313). The nearest nonattainment area for particulate matter is in Pocatello, about 80 kilometers (50 miles) to the south. Applicable NAAQS and Idaho State ambient air quality standards are presented in **Table 4–53**.

Table 4–53 Modeled Ambient Air Concentrations from INEEL Sources (μg/m^3)

Pollutant	*Averaging Period*	*Most Stringent Standard* [a]	*INEEL Concentration without ANL-W* [b]	*ANL-W Concentration* [c]
Carbon monoxide	8 hours	10,000 [d]	76	13
	1 hour	40,000 [d]	350	57
Lead	Quarterly	1.5	0.0024	(f)
Nitrogen dioxide	Annual	100 [d]	3.2	1.1
Ozone	1 hour	235 [e]	(f)	(f)
PM_{10}	Annual	50 [d]	1.2	0.018
	24 hours	150 [d]	19	0.28
Sulfur dioxide	Annual	80 [d]	0.61	0.88
	24 hours	365 [d]	16	11
	3 hours	1,300 [d]	67	62

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50), other than those for ozone, particulate matter, and lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic PM_{10} mean standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.
[b] Maximum concentrations occur at receptors along public roads.
[c] ANL-W concentrations based on 1997 actual emissions and 1996 meteorology data modeled using ISCST3.
[d] Federal and state standard.
[e] Federal 8-hour standard is currently under litigation.
[f] Not directly emitted or monitored by the site.
Note: NAAQS also include standards for lead. No sources of lead emissions have been identified for any alternative evaluated. Emissions of hazardous air pollutants not listed here have been identified at INEEL, but are not associated with any of the alternatives evaluated. EPA revised the ambient air quality standards for particulate matter and ozone in 1997 (62 FR 38856, 62 FR 38652); however, these standards are currently under litigation, but could become enforceable during the life of this project.
Sources: 40 CFR 50, DOE 1999j, DOE 2000e, ID DEQ 2000.

The primary sources of air pollutants at INEEL include combustion of coal for steam and combustion of fuel oil for heating. Other emission sources include waste burning, coal piles, industrial processes, stationary diesel engines, vehicles, and fugitive dust from waste burial and construction activities. Emissions for 1997 are presented in **Table 4–54**.

Table 4–54 Air Pollutant Emissions at INEEL in 1997 [a]

Pollutant	*Sources Other Than ANL-W*	*ANL-W*
Carbon monoxide	1.1 [b]	1.6
Nitrogen dioxide	4.4	6.6
PM_{10}	0.44	0.31
Sulfur dioxide	15	2.2
Volatile organic compounds	0.055	0.13
Lead	0.66	None

[a] Values in metric tons per year.
[b] Emissions associated with fuel combustion.
Source: DOE 1999j, INEEL 1998.

Routine offsite monitoring for nonradiological air pollutants is generally only performed for particulates. Monitoring for PM_{10} is performed by the Environmental Science and Research Foundation at the site boundary and at communities beyond the boundary. In 1998, 55 samples were collected at Rexburg (about 60 kilometers [19.3 miles] east of the site) by the Foundation. The mean PM_{10} concentration at Rexburg for 1998 was 27 micrograms per cubic meter. Forty-eight samples were collected at the Mountain View Middle School in Blackfoot, with a mean concentration of 23 micrograms per cubic meter. Forty-four samples were collected at Atomic City in 1998, with a mean concentration of 21 micrograms per cubic meter.

Some monitoring data have also been collected by the National Park Service at the Craters of the Moon Wilderness Area. The monitoring program has shown no exceedances of the 1-hour ozone standard, low levels of sulfur dioxide (except for one exceedance of the 24-hour standard in 1985), and total suspended particulates within applicable standards. Note that the total suspended particulate standards have been replaced with PM_{10} standards.

The existing ambient air concentrations attributable to sources at INEEL are presented in Table 4–53. These concentrations are based on dispersion modeling at the INEEL site boundary centered at the Idaho Nuclear Technology and Engineering Center facility, and were performed for the *Idaho High-Level Waste and Facilities Disposition Environmental Impact Statement* using 1997 actual emissions and excluding ANL-W and meteorological data from 1991-1992; dispersion modeling at the INEEL site boundary centered on ANL-W using 1997 actual emissions for ANL-W; and meteorological data from 1996. The estimated concentrations are conservative and bound the actual INEEL contribution to ambient levels, as some of the modeled sources are currently in standby. Concentrations shown in Table 4–53 represent a small percentage of the ambient air quality standards. Concentrations of any hazardous and toxic compounds would be well below regulatory levels.

Because INEEL sources are limited and background concentrations of criteria pollutants are well below ambient standards, INEEL emissions should not result in air pollutant concentrations that violate the ambient air quality standards.

The nearest Prevention of Significant Deterioration Class I area to INEEL is Craters of the Moon Wilderness Area, Idaho, 53 kilometers (33 miles) west-southwest from the center of the site. A Class I area is one in which very little increase in pollution is allowed due to the pristine nature of the area. There are no other Class I areas within 100 kilometers (62 miles) of INEEL. INEEL and its vicinity are classified as a Class II area in which more moderate increases in pollution are allowed.

EPA has established Prevention of Significant Deterioration increments for certain pollutants such as: sulfur dioxide, nitrogen dioxide, and particulate matter. The increments specify a maximum allowable increase above a certain baseline concentration for a given averaging period, and apply only to sources constructed or modified after a specified baseline date. These sources are known as increment-consuming sources. The baseline date is the date of submittal of the first application for a Prevention of Significant Deterioration permit in a given area.

Prevention of Significant Deterioration permits have been obtained for the coal-fired steam-generating facility next to the Idaho Nuclear Technology and Engineering Center and the Fuel Processing Facility, which is not expected to be operated. In addition to these facilities, INEEL has other increment consuming sources on site. Current amounts of Prevention of Significant Deterioration increment consumption in Class I and Class II areas by INEEL's increment-consuming sources based on dispersion modeling analyses are specified in **Tables 4–55** and **4–56**, respectively.

Table 4–55 Prevention of Significant Deterioration Increment Consumption at Craters of the Moon Wilderness (Class I) Area by Existing (1996) and Projected Sources Subject to Prevention of Significant Deterioration Regulation (μg/m³)

Pollutant	*Averaging Period*	*Allowable Prevention of Significant Deterioration Increment* [a]	*Amount of Prevention of Significant Deterioration Increment Consumed*
Nitrogen dioxide	Annual	2.5	0.40
Respirable particulates [b]	Annual 24 hours	4 8	0.025 0.57
Sulfur dioxide	Annual 24 hours 3 hours	2 5 25	0.12 1.9 8.1

[a] All increments specified are State of Idaho standards (ID DEQ 2000).
[b] Data on particulate size are not available for most sources. For purposes of comparison to the respirable particulate increments, it is conservatively assumed that all particulates emitted are of respirable size (i.e., 10 microns or less in diameter).
Note: Estimated increment consumption includes existing INEEL sources subject to Prevention of Significant Deterioration regulation and including Idaho Nuclear Technology and Engineering Center CPP-606 boilers.
Source: DOE 1999j.

Table 4–56 Prevention of Significant Deterioration Increment Consumption at Class II Areas by Existing (1996) and Projected Sources Subject to Prevention of Significant Deterioration Regulation at INEEL (μg/m³)

Pollutant	*Averaging Period*	*Allowable Prevention of Significant Deterioration Increment* [a]	*Amount of Prevention of Significant Deterioration Increment Consumed*
Nitrogen dioxide	Annual	25	8.8
Respirable particulates [b]	Annual 24 hours	17 30	0.53 10
Sulfur dioxide	Annual 24 hours 3 hours	20 91 512	3.6 27 120

[a] All increments specified are State of Idaho standards (ID DEQ 2000).
[b] Data on particulate size are not available for most sources. For purposes of comparison to the respirable particulate increments, it is conservatively assumed that all particulates emitted are of respirable size (i.e., 10 microns or less in diameter).
Note: Estimated increment consumption includes existing INEEL sources, subject to Prevention of Significant Deterioration regulations and include Idaho Nuclear Technology and Engineering Center CPP-606 boilers.
Source: DOE 1999j.

4.5.3.2 Radiological Releases

Primary releases of radiological air pollutants at INEEL and localized releases at ANL-W are presented in **Table 4–57**. During 1998, an estimated 5,995 curies of radioactivity were released to the atmosphere from all INEEL sources. Ninety-nine percent of the total airborne radioactive effluent was released from two INEEL facilities, the ANL-W and the Test Reactor Area. ANL-W released 4,719 curies and the Test Reactor Area released 1,201 curies. Isotopes of noble gases comprised more than 99 percent of each of their releases.

Year-to-year fluctuations in airborne radioactive effluent releases depend on which processes are active at INEEL facilities. The total for 1998 is higher than the annual totals for 1993 to 1997, primarily because of the 4,687 curies of krypton-85 released from ANL-W. Krypton-85, a noble gas, was released from ANL-W as part of a spent fuel treatment project, (the Electrometallurgical Treatment Research and Demonstration Project) in the Fuel Conditioning Facility. Although the 1998 releases were higher than in previous years, they were still considerably less than the annual totals in the 1980s.

Table 4–57 Radiological Airborne Releases to the Environment at INEEL in 1998

Emission Type	***Radionuclide*** [a]	***ANL-W (curies)***	***Other Facilities at INEEL*** [b] ***(curies)***	***Total (curies)***
Noble gases	Argon-41	2.3	1,172	1,175
	Krypton-85	4,687	0.30	4,687
	Krypton-85m	—	1.5	1.5
	Xenon-133	—	7.8	7.8
	Xenon-135	—	18.5	18.5
Airborne particulates	Sodium-24	—	0.013	0.013
	Chromium-51	—	0.0037	0.0037
	Rubidium-88	—	1.1	1.1
	Strontium-90 [c]	—	3.1×10^{-4}	3.1×10^{-4}
	Technetium-99m	—	0.0014	0.0014
	Antimony-125	—	1.3×10^{-4}	1.3×10^{-4}
	Cesium-137	—	0.0013	0.0013
	Cesium-138	—	0.050	0.050
	Uranium-234	—	0.0050	0.0050
	Plutonium-238	—	5.0×10^{-6}	5.0×10^{-6}
	Plutonium-239	—	5.3×10^{-7}	5.3×10^{-7}
Tritium, carbon-14, and iodine isotopes	Tritium (Hydrogen-3)	30	74	104
	Carbon-14	—	0.80	0.80
	Iodine-129	—	0.018	0.018
	Iodine-131	—	6.7×10^{-4}	6.7×10^{-4}
	Iodine-133	—	0.0015	0.0015
	Iodine-135	—	8.2×10^{-4}	8.2×10^{-4}
Others		4.8×10^{-5}	0.0026	0.0027
Total releases		4,719	1,276	5,995

[a] The table includes all radionuclides with total releases greater than 10^{-7} curies, except for plutonium-239. Values are not corrected for decay after release.
[b] Facilities include Idaho Nuclear Technology and Engineering Center, the Test Reactor Area, and the Naval Reactor Facility.
[c] Parent-daughter equilibrium assumed.
Note: Dashed lines indicate virtually no releases.
Source: DOE 2000f.

4.5.4 Noise

Major noise emission sources within INEEL include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Most INEEL industrial facilities are far enough from the site boundary that noise levels at the boundary from these sources are not measurable or are barely distinguishable from background levels.

Existing INEEL-related noises of public significance result from the transportation of people and materials to and from the site and in-town facilities via buses, trucks, private vehicles, and freight trains. Noise measurements along U.S. Route 20, about 15 meters (50 feet) from the roadway, indicate that traffic sound levels range from 64 to 86 dBA, and that the primary source is buses (71 to 80 dBA). While few people reside within 15 meters (50 feet) of the roadway, the results indicate that INEEL traffic noise might be objectionable to members of the public residing near principal highways or busy bus routes. Noise levels along these routes may have decreased somewhat due to reductions in employment and bus service at INEEL in the last few years. The acoustic environment along the INEEL site boundary in rural areas and at nearby areas away from traffic noise is typical of a rural location; the average day-night sound level is in the range of 35 to 50 dBA. Except for the prohibition of nuisance noise, neither the State of Idaho nor local governments have established any regulations that specify acceptable community noise levels applicable to INEEL. The EPA guidelines for environmental noise protection recommend an average day-night sound level limit of 55 dBA to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974). Land use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that annual day-night average sound levels less than 65 dBA are compatible with residential land uses (14 CFR Part 150). These guidelines further indicate that levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures. It is expected that, for most residences near INEEL, day-night average sound levels are compatible with residential land use, although noise levels may be higher than 65 dBA for some residences along major roadways.

No distinguishing noise characteristics at ANL-W have been identified. ANL-W is 7 kilometers (4.3 miles) from the nearest site boundary, so the contribution from the area to noise levels at the site boundary is unmeasurable.

4.5.5 Geology and Soils

INEEL is on the northwestern edge of the eastern Snake River Plain, which is bounded on the north and south by north-to-northwest-trending mountains and valleys of the Basin and Range Physiographic Province. The upper 1 to 2 kilometers (0.6 to 1.2 miles) of the crust beneath INEEL is composed of a sequence of Quaternary age (recent to 2 million years old) basalt lava flows and poorly consolidated sedimentary interbeds collectively called the Snake River Group. The sediments are composed of fine-grained silts that were deposited by wind; silts, sands, and gravels deposited by streams; and clays, silts, and sands deposited in lakes. Rhyolitic (granite-like) volcanic rocks of unknown thickness lie beneath the basalt sediment sequence. The rhyolitic volcanic rocks were erupted between 4.3 and 6.5 million years ago during the upper Tertiary Period. Lava tubes, which could have similar adverse effects as karst, occur in the INEEL area. Additional details about INEEL site geology are presented in the *NI PEIS*.

Within INEEL, economically viable sand, gravel, pumice, silt, clay, and aggregate resources exist. Several quarries supply these materials to various onsite construction and maintenance projects. Geothermal resources are potentially available in parts of the Eastern Snake River Plain, but neither of two boreholes drilled near the Idaho Nuclear Technology and Engineering Center encountered rocks with significant geothermal potential.

The Arco Segment of the Lost River Fault is thought to terminate about 7 kilometers (4.3 miles) from the INEEL boundary. The Howe Segment of the Lemhi Fault terminates near the northwest boundary of the site (**Figure 4–34**). Both segments are considered capable. A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years, or recurrent movement within the past 500,000 years (10 CFR Part 100, Appendix A).

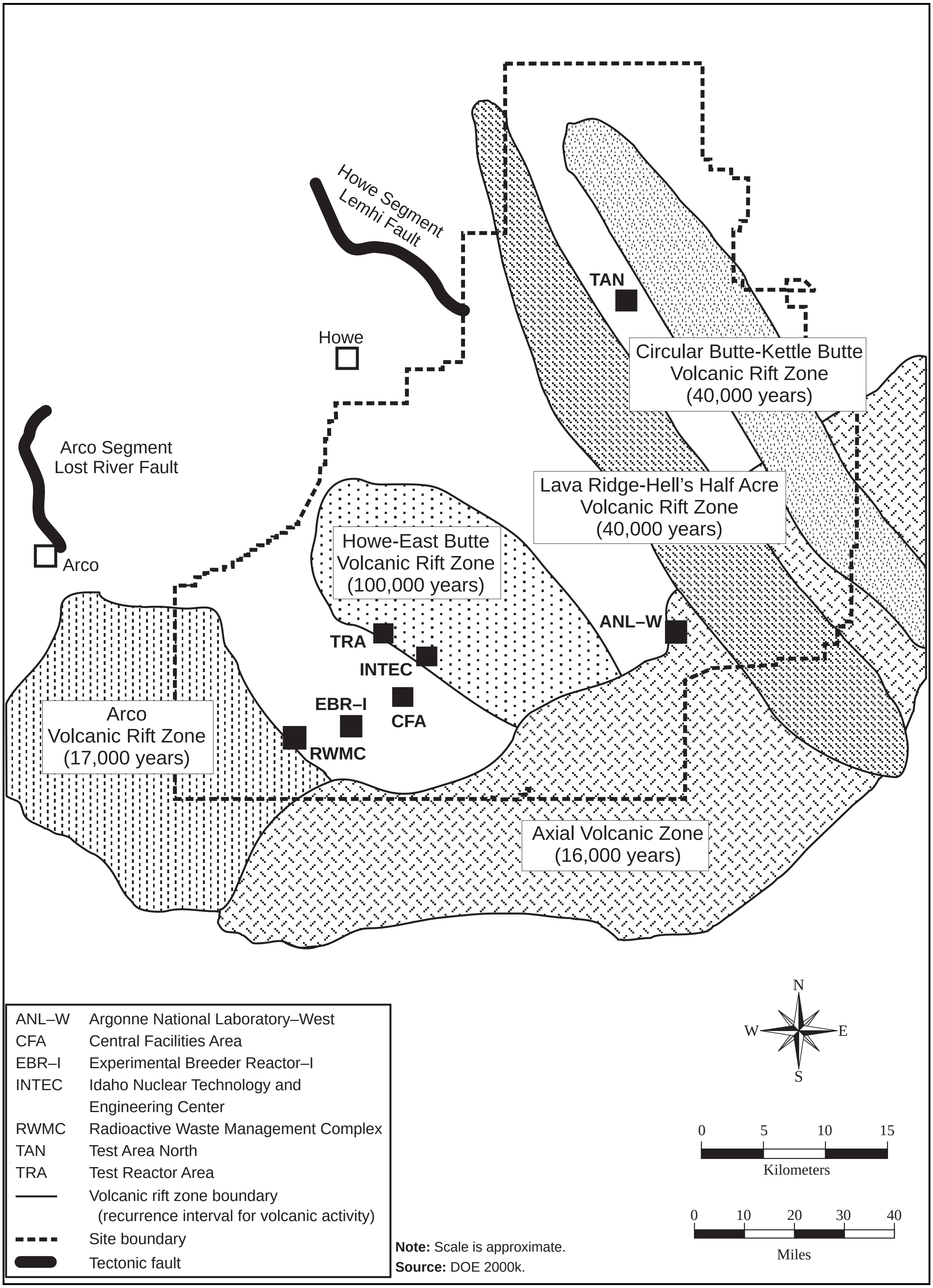


Figure 4–34 Major Geologic Features of INEEL

The seismic characteristics of the Eastern Snake River Plain and the adjacent Basin and Range Province are different; the Snake River Plain has historically experienced a few small earthquakes. Monitoring by the INEEL seismic network has detected relatively few microearthquakes (magnitude less than 1.5) occurring on or near the site. Thus, INEEL has a relatively low seismicity indicative of the Eastern Snake River Plain. Since 1973, 22 earthquakes have been recorded within 100 kilometers (62 miles) of south-central INEEL ranging in magnitude from 2.8 to a magnitude 3.9. These represent minor earthquakes with none centered closer than 77 kilometers (48 miles) from the site (USGS 2001i).

The largest historic earthquake near INEEL took place in October 1983 about 90 kilometers (56 miles) to the northwest of the western site boundary, near Borah Peak in the Lost River Range. It occurred on the middle portion of the Lost River Fault. The earthquake had a surface-wave magnitude of 7.3 (moment magnitude of 6.9), producing peak horizontal accelerations of 0.022g to 0.078g at INEEL (USGS 2001h, USGS 2001i). The reported Modified Mercalli Intensity ranged from V to IX at the event's epicenter (USGS 2001i). The Test Reactor Area (Advanced Test Reactor) experienced a Modified Mercalli Intensity of VI during this event with no damage to the Advanced Test Reactor found upon inspection. For reference, a comparison of Modified Mercalli Intensity (the observed effects of earthquakes) with measures of earthquake magnitude and ground acceleration is provided in Section F.5.2 (see Appendix F).

As discussed in more detail in Section 4.2.5, the U.S. Geological Survey has developed new earthquake hazard maps that are based on spectral response acceleration. These maps have been adapted for use in the new International Building Code (ICC 2000) and depict a maximum considered earthquake ground motion of 0.2- and 1.0-second spectral response acceleration, respectively, based on a 2 percent probability of exceedance in 50 years (i.e., 1 in 2,500). The south-central portion of INEEL encompassing ANL-W is calculated to lie within the 0.35 to 0.36g mapping contours for a 0.2 second spectral response acceleration and the 0.12g to 0.13g contours for a 1.0-second spectral response acceleration. For comparison, the calculated peak ground acceleration, for the given probability of exceedance is approximately 0.14g (USGS 2001e).

Basaltic volcanic activity occurred from about 2,100 to 4 million years ago in the INEEL site area. Although no eruptions have occurred on the Eastern Snake River Plain during recorded history, lava flows of the Hell's Half Acre lava field erupted near the southern INEEL boundary as recently as 5,400 years ago. The most recent eruptions within the site area occurred about 2,100 years ago 30 kilometers (19 miles) southwest of the site at the Craters of the Moon Wilderness Area. Five volcanic zones have been identified in the vicinity of INEEL. The estimated recurrence interval for volcanism in these zones ranges from 16,000 to 100,000 years. These zones are depicted in Figure 4–34.

Four basic soilscapes exist at INEEL: river-transported sediments deposited on alluvial plains, fine-grained sediments deposited into lake or playa basins, colluvial sediments originating from bordering mountains, and wind-blown sediments over lava flows. The alluvial deposits follow the courses of the modern Big Lost River and Birch Creek. The playa soils are found in the north-central part of the site. The colluvial sediments are located along the western edge of INEEL. Wind-blown sediments (silt and sand) covering lava plains occupy the rest of the landscape of the site. The thickness of surficial sediments ranges from less than 0.3 meters (1 foot) at basalt outcrops east of the Idaho Nuclear Technology and Engineering Center to 95 meters (312 feet) near the Big Lost River sinks. No prime farmland lies within INEEL boundaries.

The nearest capable fault to ANL-W is the Howe Segment of the Lemhi Fault, which is located 31 kilometers (19 miles) northwest of the site. ANL-W is located within the Axial Volcanic Zone, which has an estimated recurrence interval for volcanism of 16,000 years. The site is situated within a topographically closed basin. Low ridges of basalt found east of the area rise as high as 30 meters (100 feet) above the level of the plain. Sediments cover most of the underlying basalt on the plain, except where pressure ridges form basalt outcrops. Soils in the ANL-W area have been found to resemble the Pancheri-Polatis-Tenno series, which generally consists of light brown-gray well-drained silty loams to brown extremely stony loams. Soils are highly disturbed within developed areas of the site.

4.5.6 Water Resources

4.5.6.1 Surface Water

INEEL is in the Mud Lake-Lost River Basin (also known as the Pioneer Basin). This closed drainage basin includes three main streams—the Big and Little Lost Rivers and Birch Creek (**Figure 4–35**). These three streams are essentially intermittent and drain the mountain areas to the north and west of INEEL, although most flow is diverted for irrigation in the summer months before it reaches the site boundaries. Flow that reaches INEEL infiltrates the ground surface along the length of the stream beds in the spreading areas at the southern end of INEEL and, if the stream flow is sufficient, in the ponding areas (playas or sinks) in the northern portion of INEEL. During dry years, there is little or no surface water flow on INEEL site. Because the Mud Lake-Lost River Basin is a closed drainage basin, water does not flow off INEEL, but instead infiltrates the ground surface to recharge the aquifer or is consumed by evapotranspiration. The Big Lost River flows southeast from Mackay Dam, past Arco and onto the Snake River Plain. On the INEEL site near the southwestern boundary, a diversion dam prevents flooding of downstream areas during periods of heavy runoff by diverting water to a series of natural depressions or spreading areas. During periods of high flow or low irrigation demand, the Big Lost River continues northeastward past the diversion dam, passes within about 60 meters (200 feet) of the Idaho Nuclear Technology and Engineering Center, and ends in a series of playas 24 to 32 kilometers (15 to 20 miles) northeast of the Idaho Nuclear Technology and Engineering Center and the Test Reactor Area, where the water infiltrates the ground surface.

Flow from Birch Creek and the Little Lost River infrequently reaches INEEL. The water in Birch Creek and Little Lost River is diverted in summer months for irrigation prior to reaching INEEL. During periods of unusually high precipitation or rapid snow melt, water from Birch Creek and Little Lost River may enter INEEL from the northwest and infiltrate the ground, recharging the underlying aquifer. Other than the three intermittent streams, the only other surface water bodies on the site include natural wetland-like ponds and manmade percolation and evaporation ponds.

Big Lost River, Little Lost River, and Birch Creek in the vicinity of INEEL have been classified by the State of Idaho for cold water communities, salmonid spawning, and primary contact recreation, with the Big Lost River sinks and channel and lowermost Birch Creek also classified for domestic water supply and as special resource waters (Idaho Administrative Code 58.01.02). In general, the water qualities of Big Lost River, Little Lost River, and Birch Creek are similar, with the chemical qualities reflecting the carbonate mineral compositions of the mountain ranges drained by them along with the quality of irrigation water return flows. Surface waters, however, are not used for drinking water on the site, nor is effluent discharged directly to them, so there are no surface water rights issues at INEEL. Although there are no routine wastewater discharges to surface waters, an NPDES permit application has been filed with EPA Region 10 for minor discharges from the Idaho Nuclear Technology and Engineering Center production wells to the Big Lost River. However, these discharges are subject to Idaho water quality standards and criteria. INEEL facilities are also covered by EPA's NPDES Storm Water Multi-Sector General Permit issued in 1998 (63 FR 52430). Storm-water is managed via the INEEL Storm Water Pollution Prevention Plan (first implemented in 1993). Annual storm-water evaluations are conducted as part of the plan, and storm-water is monitored in accordance with the permit and with DOE Orders. In 1998, INEEL also submitted a Notice of Intent to EPA for renewal of the site's General Permit for Storm Water Discharges from Construction Sites. As for industrial activities, a pollution prevention plan covering construction activities is maintained. Applications have been made to the State of Idaho for Wastewater Land Application Permits for all existing wastewater

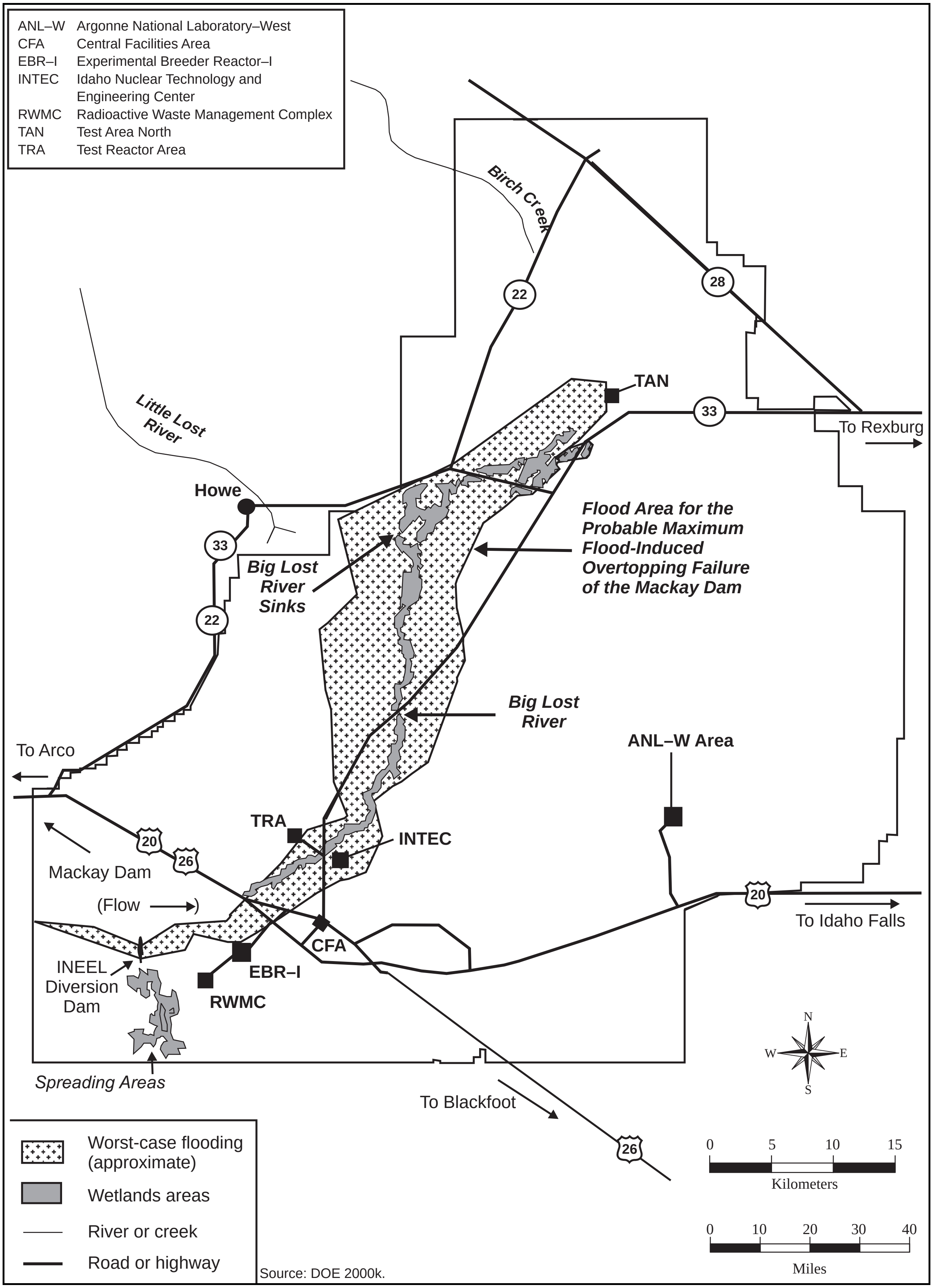


Figure 4–35 Surface Water Features at INEEL

treatment facilities on the site (e.g., percolation ponds and sewage treatment irrigation systems); four permits have been issued (DOE 2000f).

None of the rivers or streams on or near the INEEL site have been classified as a Wild and Scenic River. The INEEL diversion dam constructed in 1958 and enlarged in 1984 secured INEEL from the 300-year flood of the Big Lost River by directing flow through a diversion channel into four spreading areas.

There are no named streams within the ANL-W area and no permanent, natural, surface water features near the area. Neither the 100-year flood nor flooding scenarios that involve the failure of Mackay Dam on the Big Lost River indicate that flood waters would reach ANL-W (Figure 4–35).

4.5.6.2 Groundwater

The Snake River Plain aquifer lies below the INEEL site and covers about 2,486,000 hectares (6,143,000 acres) in southeastern Idaho and is classified by EPA as a Class I sole source aquifer. This aquifer serves as the primary drinking water source in the Snake River Basin and is believed to contain 1.2 quadrillion to 2.5 quadrillion liters (317 trillion to 660 trillion gallons) of water. The aquifer consists of 610 to 3,048 meters (2,000 to 10,000 feet) of interbedded sediments, lava flows, and rhyolite. Recharge of the groundwater comes from Henry's Fork of the Snake River, Big Lost River, Little Lost River, and Birch Creek. Rainfall and snowmelt also contribute to the aquifer's recharge. Groundwater generally flows laterally at a rate of 1.5 to 6.1 meters (5 to 20 feet) per day. Groundwater flow is toward the south-southwest. It emerges in springs along the Snake River from Milner to Bliss, Idaho. Depth to the groundwater table ranges from about 60 meters (200 feet) below ground in the northeast corner of the site to about 300 meters (1,000 feet) in the southeast corner. Perched water tables also occur below the site. These perched water tables tend to slow the migration of pollutants that might otherwise reach the Snake River Plain aquifer. Perched water tables have been detected beneath the Idaho Nuclear Technology and Engineering Center and the Test Reactor Area and are mainly attributed to disposal ponds.

INEEL has a large network of monitoring wells that are maintained and monitored by the U.S. Geological Survey. This network includes 125 observation wells in the Snake River Plain aquifer and 45 drilled to monitor perched aquifers. An additional 120 auger holes have been drilled for monitoring shallow perched groundwater. INEEL's management and operations contractor also routinely monitors drinking water quality via 17 production wells and 10 distribution systems.

Historical waste disposal practices have produced localized plumes of radiochemical and chemical constituents in the Snake River Plain Aquifer at INEEL. Of principal concern over the years have been the movements of the tritium and strontium-90 plumes.

The main sources of tritium contamination of groundwater have been the injection of wastewater through the Idaho Nuclear Technology and Engineering Center disposal well and the discharge of wastewater to the infiltration/percolation ponds at the Idaho Nuclear Technology and Engineering Center and Test Reactor Area. Since 1984, wastewater has been discharged only to the infiltration ponds, and principally to lined evaporation ponds at the Test Reactor Area since 1993. The extent of the tritium contamination plume has remained about the same since 1991; however, concentrations in well water within the plume have decreased significantly. This is attributed to radioactive decay and a decrease in tritium disposal rates.

The extent of the strontium-90 contaminant plume, which also originates from the Idaho Nuclear Technology and Engineering Center, and the concentrations of strontium-90 have remained essentially constant since 1991. This is attributed to a lack of groundwater recharge from the Big Lost River that would otherwise dilute concentrations, and to the disposal of other chemicals in the Idaho Nuclear Technology and

Engineering Center infiltration ponds which may have decreased strontium-90 adsorption to soil and rock causing more to remain in the liquid phase. Other known contaminants include cesium-137, iodine-129, strontium-90, and nonradioactive compounds such as trichloroethylene. Components of nonradioactive waste entered the aquifer as a result of past waste disposal practices. Elimination of groundwater injection exemplifies a change in disposal practices that has reduced the amount of these constituents in the groundwater. Detailed information on groundwater monitoring including analytical results are presented in the annual site environmental report.

From 1982 to 1985, INEEL used about 7.9 billion liters (2.1 billion gallons) per year from the Snake River Plain aquifer, the only source of water at INEEL. This represents less than 0.3 percent of the groundwater withdrawn from that aquifer. Since 1950, DOE has held a Federal Reserved Water Right for the INEEL site that permits a pumping capacity of approximately 2.3 cubic meters (80 cubic feet) per second, with a maximum water consumption of 43 billion liters (11.4 billion gallons) per year. Total groundwater withdrawal at INEEL historically averages between 15 and 20 percent of that permitted amount. In 1998, INEEL's production well system withdrew a total of about 4.83 billion liters (1.276 billion gallons) of water. Most of the groundwater withdrawn for use by INEEL facilities is returned to the subsurface via percolation ponds.

All water used at ANL-W is groundwater from the Snake River Plain aquifer. The depth of the groundwater at ANL-W is approximately 195 meters (640 feet), and the flow is generally to the south-southwest. ANL-W uses approximately 188 million liters (49.6 million gallons) per year of water.

No significant levels of radioactivity have been found in the production wells at ANL-W. Constituents measured in the groundwater monitoring wells in 1997 were all below regulatory levels.

4.5.7 Ecological Resources

4.5.7.1 Terrestrial Resources

INEEL lies in a cool desert ecosystem dominated by shrub-steppe communities. Most land within the site is relatively undisturbed and provides important habitat for species native to the region. Facilities and operating areas occupy 2 percent of INEEL; approximately 60 percent of the area around the periphery of the site is grazed by sheep and cattle. Although sagebrush communities occupy about 80 percent of INEEL, a total of 20 plant communities has been identified (**Figure 4–36**). In total, 398 plant taxa have been documented at INEEL.

The interspersion of low and big sagebrush communities in the northern portion of INEEL and juniper communities in the northwestern and southeastern portions of the site are considered sensitive habitats. The former provide critical winter and spring range for sage grouse and pronghorn, while the latter are important to nesting raptors and songbirds. Riparian vegetation, primarily cottonwood and willow along the Big Lost River and Birch Creek provides nesting habitat for hawks, owls, and songbirds. Recently, approximately 29,950 hectares (74,000 acres) of open space in the north-central portion of the site have been designated as the INEEL Sagebrush Steppe Ecosystem Reserve. The area represents some of the last sagebrush steppe habitat in the United States and provides habitat for numerous rare and sensitive plants and animals.

INEEL supports numerous animal species, including two amphibian, 11 reptile, 225 bird, and 44 mammal species. Common animals on the INEEL site include the short-horned lizard, gopher snake, sage sparrow, Townsend's ground squirrel, and black-tailed jackrabbit. Important game animals include the sage grouse, mule deer, elk, and pronghorn. During some winters, 4,500 to 6,000 pronghorn, or about 30 percent of Idaho's total pronghorn population, may be found on the INEEL site. Pronghorn wintering areas are located

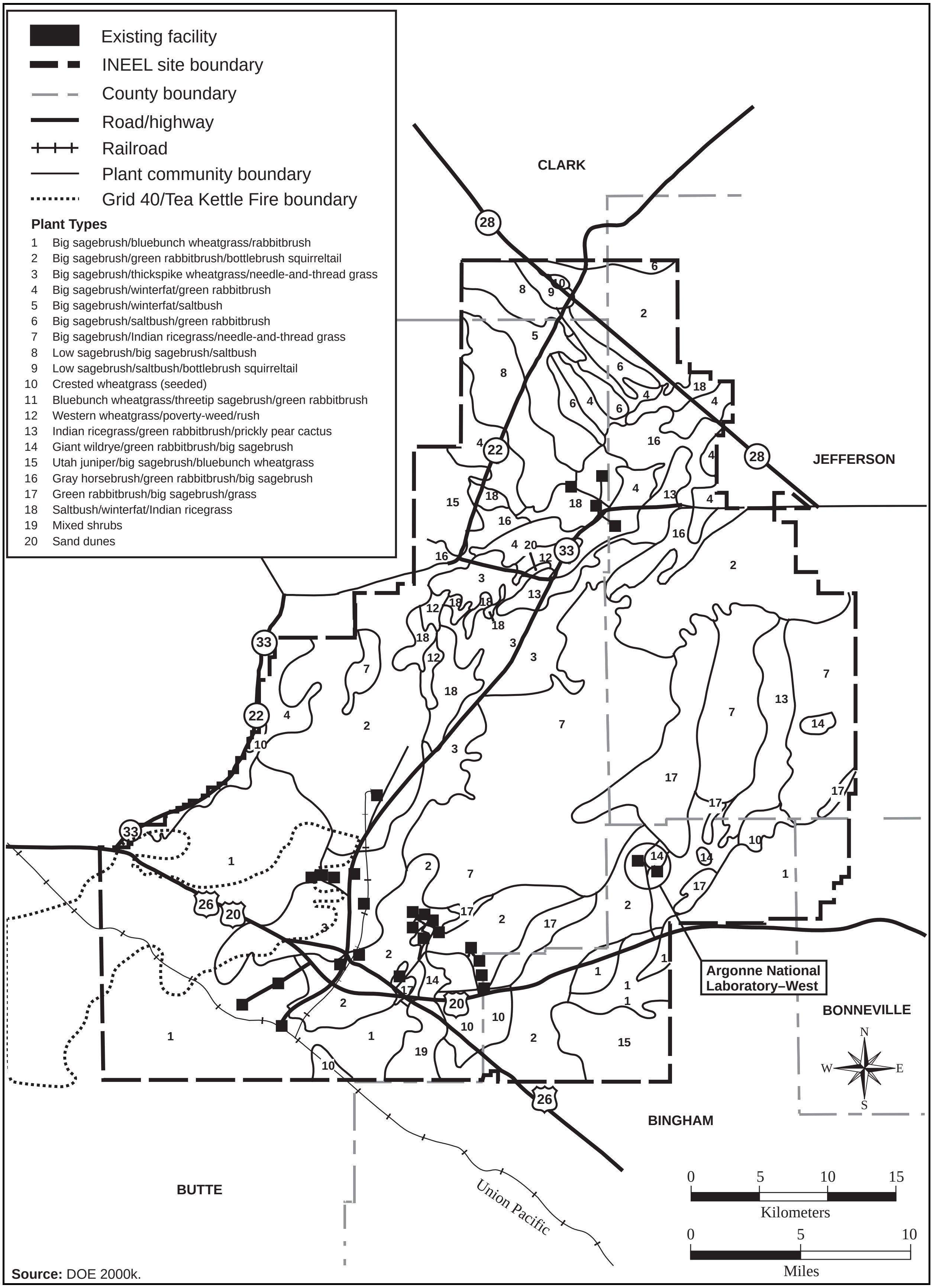


Figure 4–36 Vegetation Association at INEEL

in the northeastern portion of the site, in the area of the Big Lost River sinks, in the west-central portion of the site along the Big Lost River, and in the south-central portion of the site. Hunting elk and pronghorn is permitted only within 0.8 kilometers (0.5 miles) of the site boundary on INEEL lands adjacent to agricultural lands. Numerous raptors, such as the golden eagle and prairie falcon, and carnivores, such as the coyote and mountain lion, are also found on INEEL. A variety of migratory birds have been found at INEEL. Migratory birds are protected under the Migratory Bird Treaty Act.

Large wildfires in 1994, 1995, 1996, and 1999 played an important role in the ecology of INEEL. The most recent large fire, the Grid 40/Tea Kettle Fire, burned 19,830 hectares (49,000 acres) across the southwestern portion of the site between July 27 and 28, 2000 (INEEL 2000). The immediate effect of the fire on ecological resources at INEEL, aside from plants and animals that perished as a direct result of the fire, was the displacement of animals from their habitat. A longer-term concern is that non-native, invasive plant species may have a greater competitive advantage at the expense of native grasses and shrubs, especially where the ground was disturbed by fire fighting activities. Of particular concern is the loss of sagebrush, the dominant shrub of the shrub-steppe community. This plant is slow to regenerate since it must do so from seed, whereas many other plants regenerate from underground root systems. The slow recovery of sagebrush is likely to have a detrimental impact on the sage grouse (a bird that has been declining over much of its range) which is dependent on this plant, particularly for critical winter habitat.

ANL-W is located within one of several sagebrush communities found on the INEEL site (Figure 4–35). While sagebrush is present on undeveloped portions of the site, developed areas are nearly devoid of vegetation. Wildlife use of developed portions of the site is negligible; however, surrounding areas do provide natural habitat for a variety of wildlife. While elk and mule deer are the most important large mammals present in the area, many of the common species discussed above also would be expected. The ANL-W wastewater pond acts as an important source of water for wildlife found in the vicinity of the site.

4.5.7.2 Wetlands

National Wetland Inventory maps prepared by the USFWS have been completed for most of INEEL. These maps indicate that the primary wetland areas are associated with the Big Lost River, the Big Lost River spreading areas, and the Big Lost River sinks, although smaller (less than about 0.4 hectares [1 acre]) isolated wetlands also occur. Wetlands associated with the Big Lost River are classified as riverine/intermittent, indicating a defined stream channel with flowing water during only part of the year. The only areas of jurisdictional wetland are the Big Lost River sinks. Wetland areas on INEEL are shown in Figure 4–35.

Wetland vegetation exists along the Big Lost River, which is located 18 kilometers (11 miles) west of ANL-W; however, this vegetation is in poor condition because of recent years of only intermittent flows. The Big Lost River spreading areas and Big Lost River sinks are seasonal wetlands and are located 34 kilometers (21 miles) west-southwest and 23 kilometers (14 miles) northwest of ANL-W, respectively. These areas can provide more than 809 hectares (2,000 acres) of wetland habitat during wet years. Within ANL-W itself, small areas of intermittent marsh occur along cooling tower blowdown ditches.

4.5.7.3 Aquatic Resources

Aquatic habitat on the INEEL site is limited to the Big Lost River, Little Lost River, Birch Creek, and a number of liquid waste disposal ponds. All three streams are intermittent and drain into four sinks in the north-central part of the site. Six species of fish have been observed within water bodies located on site. Species observed in the Big Lost River include: brook trout, rainbow trout, mountain whitefish, speckled dace, shorthead sculpin, and kokanee salmon. The Little Lost River and Birch Creek, northwest and northeast of the Test Reactor Area, respectively, enter the INEEL site only during periods of high flow.

Surveys of fish in these surface water bodies have not been conducted. The liquid waste disposal ponds on the INEEL site, while considered aquatic habitat, do not support fish.

There is no natural aquatic habitat on or in the vicinity of the ANL-W site. The nearest such habitat is the Big Lost River, which is located 18 kilometers (11 miles) west of the site. ANL-W waste disposal ponds do not contain any fish populations, but do provide habitat for a variety of aquatic invertebrates.

4.5.7.4 Threatened and Endangered Species

There are three agencies that have authority to designate threatened, endangered, and sensitive species in Idaho. The agencies are the USFWS, the Idaho Department of Fish and Game, and the U.S. Forest Service. The U.S. Forest Service lists species for special management consideration on lands under their jurisdiction and protects these species under the authority of the Endangered Species Act of 1973.

Fifteen Federal- and state-listed threatened, endangered, and other special status species occur, or possibly occur, on the INEEL site (**Table 4–58**). The bald eagle is listed by the USFWS as threatened (but is proposed for delisting) and by the State of Idaho as endangered. The bald eagle has rarely been seen in the western and northern portions of the INEEL site. The gray wolf (listed endangered, experimental population) has been sighted several times on the INEEL site since 1993. On July 27 and 28, 2000, the Grid 40/Tea Kettle Fire burned across 19,830 hectares (49,000 acres) of the southwestern portion of the INEEL site. DOE is currently assessing the impacts of that fire on threatened and endangered species and species of concern. No critical habitat for threatened or endangered species, as defined in the Endangered Species Act, exists on the INEEL site.

The ANL-W area was surveyed in 1996 for threatened, endangered, and special status species. The only listed species observed were the peregrine falcon and the loggerhead shrike. While no peregrine falcon nests were found near ANL-W, one peregrine falcon was observed perched on a power line 1.5 kilometers (0.9 miles) from the site. Since then, the peregrine falcon has been delisted. The loggerhead shrike, which is listed by Idaho as a species of concern, has been seen on numerous occasions in the vicinity of the site. The gray wolf (state endangered) and the pigmy rabbit and Townsend's big-eared bat (state species of concern) were not identified in the vicinity of ANL-W during the surveys. In addition, no Federally or state-listed plants were found in the vicinity of the site.

4.5.8 Cultural and Paleontological Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. INEEL has a well-documented record of cultural and paleontological resources. Past studies, which covered 4 percent of the site, identified 1,506 cultural resource sites and isolated finds, including 688 prehistoric sites, 38 historic sites, 753 prehistoric isolates, and 27 historic isolates. As of January 1998, approximately 7 percent of INEEL had been surveyed, raising the number of potential archeological sites to 1,839. Most surveys have been conducted near significant facility areas in conjunction with major modification, demolition, or abandonment of site facilities.

Cultural sites are often occupied continuously or intermittently over substantial timespans. For this reason, a single location may contain evidence of use during both historic and prehistoric periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented. However, the sum of these resources may be greater than the total number of sites reported due to such dual-use histories at sites. Therefore, where the total number of sites reported is less than the sum of prehistoric and historic sites, certain locations were used during both periods. DOE is currently evaluating the impacts to cultural resources from fire suppression activities during the Grid 40/Tea Kettle fire that burned across 19,830 hectares (49,000 acres) of the southwestern portion of the INEEL site on July 27 and 28, 2000.

Table 4–58 Listed Threatened and Endangered Species, Species of Concern, and Other Unique Species that Occur or May Occur at INEEL

Species	*Federal Classification*	*State Classification*	*Occurrence on INEEL*
Mammals			
Gray wolf	Endangered/Experimental Population	Endangered	Several sightings since 1993
Long-eared myotis	Special Concern	Unlisted	Limited onsite distribution
Small-footed myotis	Special Concern	Unlisted	Limited onsite distribution
Townsend's big-eared bat	Special Concern	Special Concern	Year-round resident
Pygmy rabbit	Special Concern	Special Concern	Limited onsite distribution
Merriam's shrew	Special Concern	Unlisted	Limited onsite distribution
Birds			
American peregrine falcon	Special Concern	Endangered	Winter visitor
Bald eagle	Threatened	Endangered	Winter visitor most years
Boreal owl	Special Concern	Special Concern	Recorded, but not confirmed
Ferruginous hawk	Special Concern	Protected	Widespread summer resident
Flammulated owl	Special Concern	Special Concern	Recorded, but not confirmed
Long-billed curlew	Special Concern	Protected	Limited summer distribution
Greater sage grouse	Special Concern	Unlisted	Year-round resident
Plants			
Lemhi milkvetch	Unlisted	Idaho Native Plant Society-State Priority 3	Limited distribution
Painted milkvetch	Special Concern	Unlisted	Limited distribution
Speal-tooth dodder	Unlisted	Idaho Native Plant Society-State Priority 1	Found near, but not on the INEEL site
Spreading gilia	Unlisted	Idaho Native Plant Society-State Priority 2	Common in western foothills
Ute's ladies tresses	Threatened	Idaho Native Plant Society-Global Priority 2	Found near, but not on the INEEL site
Winged-seed evening primrose	Unlisted	Idaho Native Plant Society-Sensitive	Rare and limited
Reptiles			
Northern sagebrush lizard	Special Concern	Unlisted	Limited distribution

Sources: DOE 1999j, USFWS 2001.

4.5.8.1 Prehistoric Resources

Prehistoric resources identified at INEEL are generally reflective of Native American hunting and gathering activities. A total of 688 prehistoric sites and 753 prehistoric isolates have been located. Most of the prehistoric sites are lithic scatters or locations (DOE 1996g). Resources appear to be concentrated along the Big Lost River and Birch Creek, atop buttes, and within craters or caves. They include residential bases, campsites, caves, hunting blinds, rock alignments, and limited-activity locations such as lithic and ceramic scatters, hearths, and concentrations of fire-affected rock. Most sites have not been formally evaluated for nomination to the National Register of Historic Places, but are considered to be potentially eligible. Given the rather high density of prehistoric sites at INEEL, additional sites are likely to be identified as surveys continue.

The most recent cultural resource survey conducted near ANL-W took place in 1996 and covered an area to the south of the site that had been burned over by a wildfire and was proposed for revegetation. A total of 12 isolated finds and 2 archaeological sites were located. Isolated finds include items such as pieces of Shoshone brownware pottery and projectile points. The archaeological sites include projectile points, scrappers, and volcanic glass flakes. Areas within the fenced portion of the ANL-W site are highly disturbed and are not likely to yield significant archaeological material.

4.5.8.2 Historic Resources

Thirty-eight historic sites and 27 historic isolates have been identified at the INEEL site. These resources are representative of European-American activities, including fur trapping and trading, immigration, transportation, mining, agriculture, and homesteading, as well as more recent military and scientific/engineering research and development activities. Examples of historic resources include Goodale's Cutoff (a spur of the Oregon Trail), remnants of homesteads and ranches, irrigation canals, and a variety of structures from the World War II era. The Experimental Breeder Reactor I, the first reactor to achieve a self-sustaining chain reaction using plutonium instead of uranium as the principal fuel component, is listed on the National Register of Historic Places and is designated as a National Historic Landmark. Many other INEEL structures built between 1949 and 1974 are considered eligible for the National Register because of their exceptional scientific and engineering significance, and their major role in the development of nuclear science and engineering since World War II. Additional historic sites are likely to exist in unsurveyed portions of INEEL.

A number of recent items, including farm implements, a belt buckle, broken glass, and a large scattering of cans, have been found in the vicinity of ANL-W. EBR-II has been designated as an American Nuclear Society Historical Landmark.

4.5.8.3 Native American Resources

Native American resources at INEEL are associated with the two groups of nomadic hunters and gatherers that used the region at the time of European-American contact: the Shoshone and Bannock. Both of these groups used the area that now encompasses INEEL as they harvested plant and animal resources and obsidian from Big Southern Butte and Howe Point. Because the INEEL site is considered part of the Shoshone-Bannock Tribes' ancestral homeland, it contains many localities that are important for traditional, cultural, educational, and religious reasons. This includes not only prehistoric archaeological sites that are important in the context of a religious or cultural heritage, but also features of the natural landscape and air, plant, water, and animal resources that have special significance.

Although prehistoric Native American resources have been found in the vicinity of ANL-W (see Section 4.5.8.1), the 1994 Memorandum of Agreement with the Shoshone-Bannock Tribes does not affect the site.

4.5.8.4 Paleontological Resources

The region encompassing INEEL has abundant and varied paleontological resources, including plant, vertebrate, and invertebrate remains in soils, lake and river sediments, and organic materials found in caves and archaeological sites. Vertebrate fossils recovered from the Big Lost River floodplain consist of isolated bones and teeth from large mammals of the Pleistocene or Ice Age. These fossils were discovered during excavations and well drilling operations. Fossils have been recorded in the vicinity of the Naval Reactors Facility. Occasional skeletal elements of fossil mammoth, horse, and camel have been retrieved from the Big Lost River diversion dam and Radioactive Waste Management Complex on the southwestern side of the

INEEL site, and from river and alluvial fan gravels and Lake Terreton sediments near Test Area North. In total, 24 paleontological localities have been identified on the INEEL site. Paleontological resources were not found in the immediate vicinity of ANL-W during a recent archaeological survey.

4.5.9 Socioeconomics

Statistics for population, housing, community services, and local transportation are presented for the region of influence, a four-county area in Idaho (**Figure 4–37**) in which 94.4 percent of all INEEL employees reside (**Table 4–59**). In 1997, INEEL employed 8,291 persons.

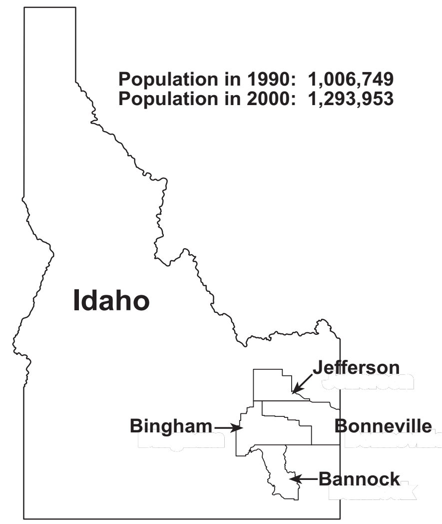


Figure 4–37 Counties in the ANL-W Region of Influence

4.5.9.1 Regional Economic Characteristics

Between 1994 and 1999, the civilian labor force in the region of influence increased 6.8 percent, to the 1999 level of 119,149. In 1999, the annual unemployment average in the four-county area was 4.5 percent, which was slightly less than the annual unemployment average for Idaho (5.2 percent) (DOL 2000).

In 1997, service activities represented the largest sector of employment in the region of influence (24.9 percent). This was followed by retail trade (21.1 percent), and government (20.2 percent). The totals for these employment sectors in Idaho were 24.1 percent, 19.5 percent, and 18.3 percent, respectively (ID DOL 1999).

Table 4–59 Distribution of Employees by Place of Residence in the INEEL Region of Influence in 1997

County	*Number of Employees*	*Total Site Employment (percent)*
Bonneville	5,553	67.0
Bingham	1,077	13.0
Bannock	615	7.4
Jefferson	583	7.0
Region of influence total	7,828	94.4

Source: DOE 2000k.

4.5.9.2 Demographic Characteristics

The 2000 demographic profile of the region of influence population is included in **Table 4–60**. The 2000 population in the four-county area was 218,977 people. The predominant population in the region of influence is white; 7.6 percent of the population have a Hispanic or Latino ethnic background.

Income information for the INEEL region of influence is included in **Table 4–61**. In 1997, the median household incomes in each of the four counties in the region of influence were higher than the Idaho state average $33,612. However, with the exception of Bonneville County, these counties had a larger percent of persons living below the poverty line as compared to the state average.

Table 4–60 Demographic Profile of the Population in the INEEL Region of Influence

	Bannock County	*Bingham County*	*Bonneville County*	*Jefferson County*	*Region of Influence*
Population					
2000 Population	75,565	41,735	82,522	19,155	218,977
1990 Population	66,026	37,583	72,207	16,543	192,359
Percent change from 1990 to 2000	14.4	11.0	14.3	15.8	13.8
Race (2000) (percent of total population)					
White	91.3	82.4	92.8	90.9	90.1
Black or African American	0.6	0.2	0.5	0.3	0.4
American Indian and Alaska Native	2.9	6.7	0.6	0.5	2.6
Asian	1.0	0.6	0.8	0.2	0.8
Native Hawaiian and other Pacific Islander	0.2	0.0	0.1	0.1	0.1
Some other race	2.1	8.0	3.7	6.8	4.2
Two or more races	2.0	2.1	1.5	1.3	1.8
Percent minority	10.5	21.4	9.8	11.5	12.4
Ethnicity (2000)					
Hispanic or Latino	3,540	5,550	5,703	1,907	16,700
Percent of total population	4.7	13.3	6.9	10.0	7.6

Source: DOC 2001.

Table 4–61 Income Information for the INEEL Region of Influence

	Bannock	*Bingham*	*Bonneville*	*Jefferson*	*Idaho*	*USA*
Median household income 1997 ($)	35,382	34,488	39,962	34,390	33,612	37,005
Percent of persons below poverty line (1997)	13.9	14.7	12.2	13.1	13.0	13.3

Source: DOC 2000.

4.5.9.3 Housing and Community Services

Table 4–62 lists the total number of occupied housing units and vacancy rates in the region of influence. In 1990, the region of influence contained 69,760 housing units, of which 64,085 were occupied. The median value of owner-occupied units ranged from $63,700 in Bonneville County to $50,700 in Bingham County. The vacancy rate was lowest in Bonneville County (6.8 percent) and highest in Bingham County (9.1 percent) (DOC 1998).

Community services include public education and health care (i.e., hospitals, hospital beds, and doctors). In 1998, student enrollment in the four-county area totaled 49,361 with a student-to-teacher ratio of 19:1 (Department of Education 2000). In 1998, four hospitals served the region of influence with a hospital bed-to-population ratio of 3 hospital beds per 1,000 persons. The average physician-to-population ratio in the four-county area was 1.5 physicians per 1,000 persons (Gaquin and DeBrandt 2000).

4.5.9.4 Local Transportation

U.S. Highways 20 and 26 are the main access routes to the southern portion of the INEEL site and State Routes 22 and 33 provide access to the northern INEEL facilities (Figure 4–32).

DOE buses provide transportation between INEEL facilities and Idaho Falls for DOE and contractor personnel. The major railroad in the area is the Union Pacific Railroad. The railroad's Blackfoot-to-Arco Branch provides rail service to the southern portion of the INEEL site. A DOE-owned spur connects the Union Pacific Railroad to INEEL by a junction at Scoville Siding. There are no navigable waterways within the area capable of accommodating waterborne transportation of material shipments to INEEL. Fanning Field in Idaho Falls and Pocatello Municipal Airport in Pocatello provide jet air passenger and cargo service for both national and local carriers. Numerous smaller private airports are located throughout the region of influence.

Table 4–62 Housing and Community Services in the INEEL Region of Influence

	Bannock County	*Bingham County*	*Bonneville County*	*Jefferson County*	*Region of Influence*
Housing (1990) [a]					
Total units	25,694	12,664	26,049	5,353	69,760
Occupied housing units	23,412	11,513	24,289	4,871	64,085
Vacant units	2,282	1,151	1,760	482	5,675
Vacancy rate (percent)	8.9	9.1	6.8	9.0	8.1
Median value ($)	53,300	50,700	63,700	54,300	Not available
Public Education [b]					
Total enrollment	14,504	10,719	18,623	5,515	49,361
Student-to-teacher ratio	19.2:1	18.5:1	19.2:1	19.1:1	19.0:1
Community Health Care (1998) [c]					
Hospitals	2	1	1	0	4
Hospital beds per 1,000 persons	3.3	2.9	3.4	0	3.0
Physicians per 1,000 persons	2.0	0.5	1.90	0.2	1.5

[a] DOC 1998.
[b] Department of Education 2000.
[c] Gaquin and DeBrandt 2000.

4.5.10 Environmental Justice

Under Executive Order 12898, DOE is responsible for identifying and addressing disproportionately high and adverse impacts on minority or low-income populations. As discussed in Appendix E, minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multiracial. Persons whose income is below the Federal poverty threshold are designated as low-income.

ANL-W is located at latitude 43° 35' 41.7" north, longitude 112° 39' 18.7" west. **Figure 4–38** shows the region of potential radiological impacts and the location of the Fort Hall Indian Reservation. As shown in the figure, the region includes Idaho Falls and portions of the Fort Hall Indian Reservation and Pocatello.

Fourteen counties in Idaho are included or partially included in the potentially affected area: Bannock, Bingham, Blaine, Bonneville, Butte, Clark, Caribou, Custer, Fremont, Jefferson, Lemhi, Madison, Minidoka, and Power (see **Figure 4–39**). **Table 4–63** provides the racial and Hispanic composition for these counties using data obtained from the decennial census conducted in 2000. In the year 2000, approximately 13 percent of the county residents identified themselves as members of a minority group. Hispanics and American Indians or Alaska Natives comprised more than 80 percent of the minority population.

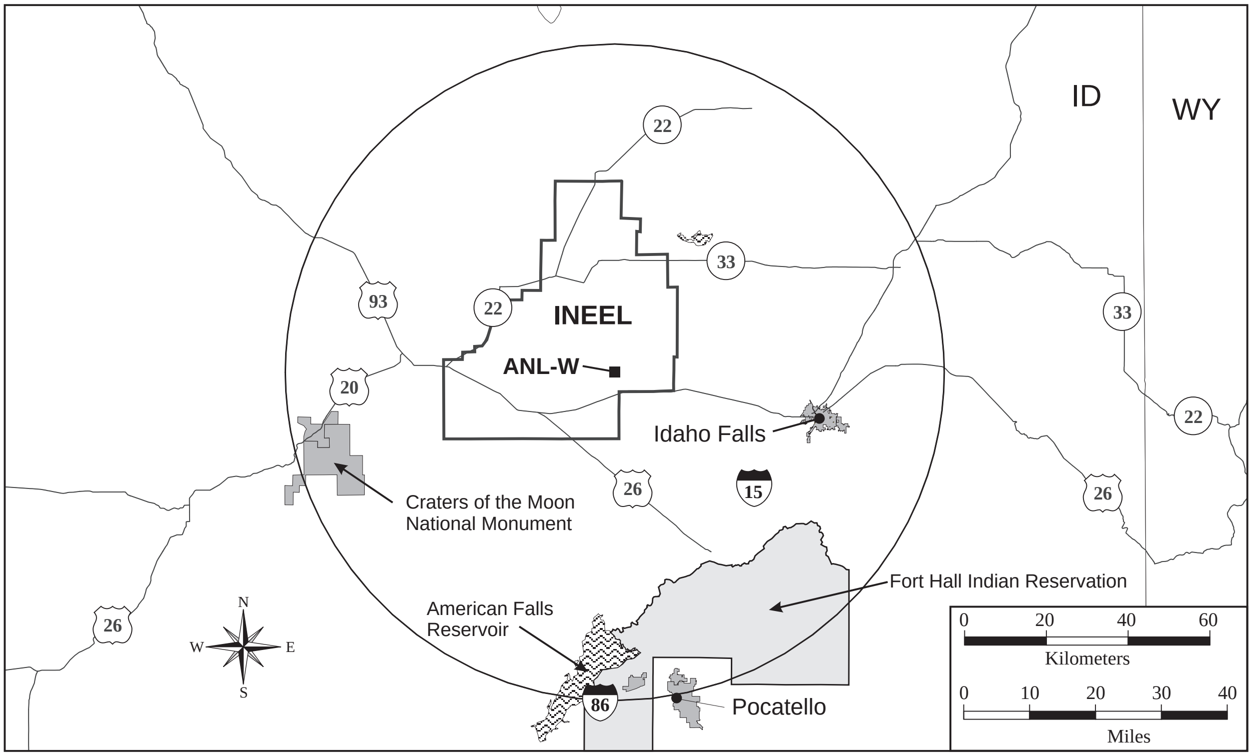


Figure 4–38 Location of the ANL-W and the Fort Hall Indian Reservation

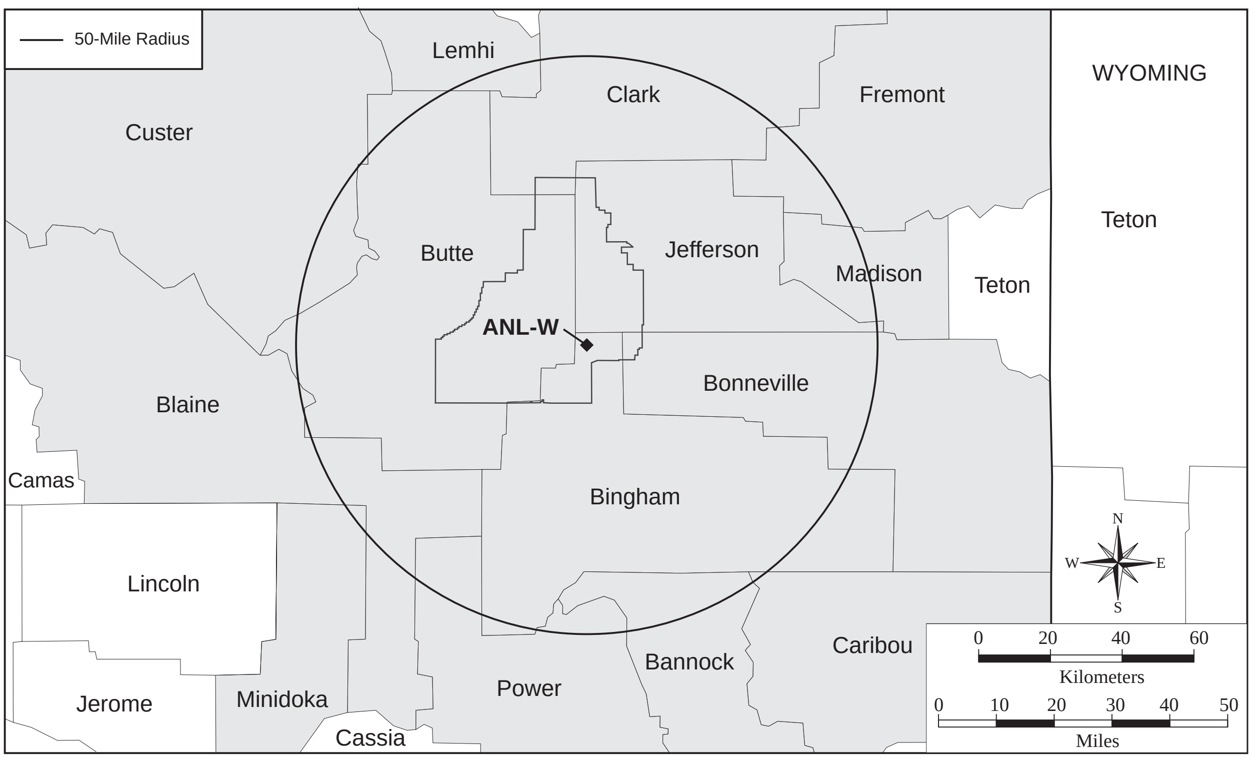


Figure 4–39 Potentially Affected Counties near ANL-W

Table 4–63 Populations in Potentially Affected Counties Surrounding ANL-W in 2000

Population Group	*Population*	*Percentage of Total*
Minority	41,547	12.7
Hispanic	28,950	8.8
Black/African American	990	0.3
American Indian/Alaska Native	5,702	1.7
Asian	2,125	0.6
Native Hawaiian/Pacific Islander	277	0.1
Two or More Races	3,503	1.1
Some Other Race	225	0.1
White	286,567	87.3
Total	328,339	100.0

Figure 4–40 compares the growth in the minority populations in the potentially affected counties between 1990 and 2000. As discussed in Section E.5.1 of Appendix E, data concerning race and Hispanic origin from the 2000 Census cannot be directly compared with that for the 1990 Census because the racial categories used in the two enumerations were different. Bearing this change in mind, the minority population in potentially affected counties increased from approximately 9 percent to 13 percent in the decade from 1990 to 2000. More than 80 percent of the increase in the resident minority population was due to the increases in Hispanic or Latino and American Indian or Alaska Native populations. In the same decade, the percentage minority population of Idaho increased from approximately 8 percent to 12 percent.

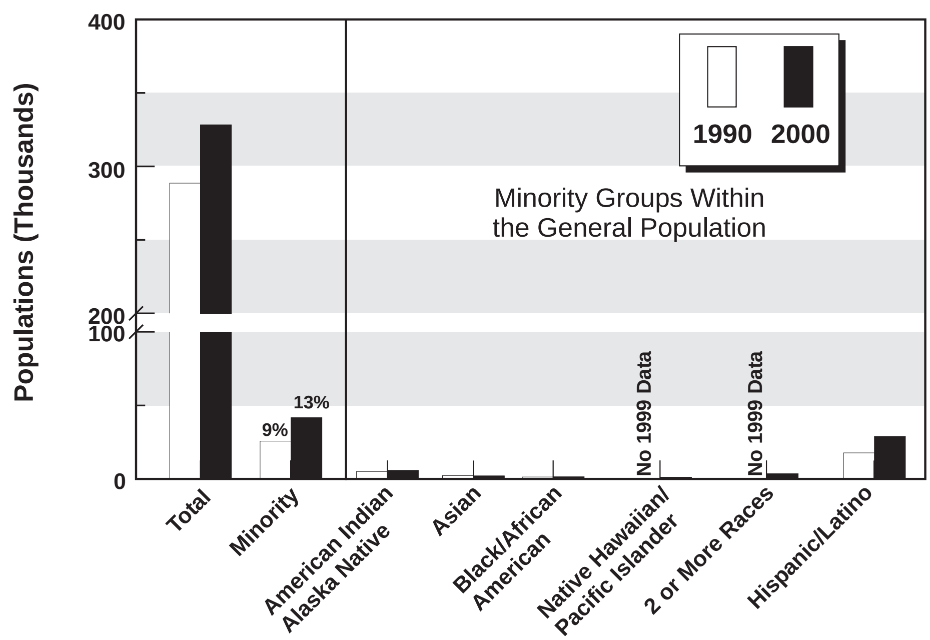


Figure 4–40 Comparison of Populations in Potentially Affected Counties Surrounding ANL-W in 1990 and 2000

The percentage of low-income population residing in potentially affected counties surrounding ANL-W in 1990 was approximately 13 percent. In 1990, nearly 13 percent of the total population of the continental United States reported incomes less than the poverty threshold. In terms of percentages, minority populations in potentially impacted counties are relatively small in comparison with the national percentage, while the low-income resident population in 1990 is commensurate with the corresponding national percentage.

Complete census data with block group resolution for minority and low-income populations obtained from the decennial census of 2000 are scheduled for publication in 2002.

4.5.11 Existing Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health that result from acute and chronic exposures to ionizing radiation and hazardous chemicals.

4.5.11.1 Radiation Exposure and Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of INEEL are shown in **Table 4–64**. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to INEEL operations.

Table 4–64 Sources of Radiation Exposure to Individuals in the INEEL Vicinity Unrelated to INEEL Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural Background Radiation	
External (terrestrial and cosmic) [a]	119
Internal terrestrial and global cosmogenic [b]	40
Radon in homes (inhaled)	200 [b, c]
Other Background Radiation [b]	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	less than 1
Air travel	1
Consumer and industrial products	10
Total	424

[a] DOE 2000f.
[b] NCRP 1987.
[c] An average for the United States.

Releases of radionuclides to the environment from INEEL operations provide another source of radiation exposure to individuals in the vicinity of INEEL. Types and quantities of radionuclides released from INEEL operations in 1998 are listed in the *Idaho National Engineering and Environmental Laboratory Site Environmental Report for Calendar Year 1998* (DOE 2000f). The releases are summarized in Section 4.5.3.2 of this EIS. The doses to the public resulting from these releases are presented in **Table 4–65.** These doses fall within the radiological limits given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those of background radiation.

Using a risk estimator of one latent cancer death per 2,000 person-rem to the public (see Appendix B), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from INEEL operations in 1998 is estimated to be 4.0×10^{-9}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with one year of INEEL operations is 4 in 1 billion (it takes several to many years from the time of radiation exposure for a cancer to manifest itself).

Table 4–65 Radiation Doses to the Public From Normal INEEL Operations in 1998 (total effective dose equivalent)

Members of the Public	*Atmospheric Releases*		*Liquid Releases*		*Total*	
	Standard [a]	*Actual*	*Standard* [a]	*Actual*	*Standard* [a]	*Actual*
Maximally exposed offsite individual (millirem)	10	0.008	4	0	100	0.008
Population within 80 kilometers (50 miles) (person-rem) [b]	None	0.075	None	0	100	0.075
Average individual within 80 kilometers (50 miles) (millirem) [c]	None	0.00062	None	0	None	0.00062

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that Order, the 10-millirem per year limit from airborne emissions is required by the Clean Air Act (40 CFR 61), and the 4-millirem per year limit is required by the Safe Drinking Water Act (40 CFR 141). The total dose of 100 millirem per year is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, *Radiation Protection of the Public and Environment; Proposed Rule*, as published in 58 FR 16268. If the potential total dose exceeds the 100 person-rem value, the contractor operating the facility would be required to notify DOE.

[b] Based on an estimated population of 121,500 in 1998.

[c] Obtained by dividing the population dose by the number of people living within 80 kilometers (50 miles) of the site.

Source: DOE 2000f.

According to the same risk estimator, 3.8×10^{-5} excess fatal cancers are projected in the population living within 80 kilometers (50 miles) of INEEL from normal operations in 1998. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The mortality rate associated with cancer for the entire U.S. population is 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 1998 from all causes in the population living within 80 kilometers (50 miles) of INEEL was 243. This expected number of fatal cancers is much higher than the 3.8×10^{-5} fatal cancers estimated from INEEL operations in 1998.

INEEL workers receive the same dose as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at INEEL from operations in 1998 are presented in **Table 4–66**. These doses fall within the radiological regulatory limits of 10 CFR 835. According to a risk estimator of one latent fatal cancer per 2,500 person-rem among workers (see Appendix B), the number of projected fatal cancers among INEEL workers from normal operations in 1998 is 0.026. The risk estimator for workers is lower than the estimator for the public because of the absence from the work force of the more radiosensitive infant and child age groups.

Table 4–66 Radiation Doses to Workers From Normal INEEL Operations in 1998 (total effective dose equivalent)

Occupational Personnel	*Onsite Releases and Direct Radiation*	
	Standard [a]	*Actual*
Average radiation worker (millirem)	None [b]	87 [c]
Total workers [d] (person-rem)	None	65 [c]

[a] The radiological limit for an individual worker is 5,000 millirem per year (10 CFR 835). However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. Therefore, DOE has recommended an administrative control level of 500 millirem per year (DOE 1999e); the site must make reasonable attempts to maintain individual worker doses below this level.

[b] No standard is specified for an average radiation worker; however, the maximum dose that this worker may receive is limited to that given in footnote a.

[c] Does not include doses received at the Naval Reactors Facility. The impacts associated with this facility fall under the jurisdiction of the Navy as part of the Nuclear Propulsion Program.

[d] There were 743 workers with measurable doses in 1998.

Source: DOE 1998c.

External radiation doses have been measured on the ANL-W site that may contain radiological sources for comparison with offsite natural background radiation levels. Measurements taken in 1998 showed an average onsite dose at ANL-W of 140 millirem compared to an offsite dose of 128 millirem (DOE 1998c).

External concentrations of plutonium, gross alpha, and beta radiation in air have been measured at ANL-W. The concentrations in air of plutonium-239/240 in 1996 were 3.4×10^{-18} curies per cubic meter. This value is essentially the same as that measured at an offsite control location. Concentrations in air of gross alpha and beta radiation at ANL-W in 1998 were 7.1×10^{-16} curies per cubic meter and 2.2×10^{-14} curies per cubic meter, respectively. These alpha and beta radiation concentrations are about the same as those measured at offsite control locations.

4.5.11.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway).

Adverse health impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at INEEL via inhalation of air containing hazardous chemicals released to the atmosphere by INEEL operations. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential pathways.

Baseline air emission concentrations for air pollutants and their applicable standards are presented in Section 4.5.3.1. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are compared with applicable guidelines and regulations.

Chemical exposure pathways to INEEL workers during normal operation may include inhaling the workplace atmosphere, drinking INEEL potable water, and possible other contacts with hazardous materials associated with work assignments. Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. INEEL workers are also protected by adherence to Occupational Safety and Health Administration and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at INEEL are substantially better than required by standards.

4.5.11.3 Health Effects Studies

Epidemiological studies were conducted on communities surrounding INEEL to determine whether there are excess cancers in the general population. Two of these are described in more detail in Appendix M.4.4 of the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996g). No excess cancer mortality was reported, and although excess cancer incidence was observed, no association with INEEL was established. A study by the State of Idaho completed in June 1996 found excess brain cancer incidence in the six counties surrounding INEEL, but a follow-up survey concluded that there was nothing that clearly linked all these cases to one another or any one thing (DOE 1996g).

Researchers from the Boston University School of Public Health, in cooperation with the National Institute of Occupational Safety and Health, are investigating the effects of work force restructuring (downsizing) in the nuclear weapons industry. The health of displaced workers will be studied. Under a National Institute of Occupational Safety and Health cooperative agreement, the epidemiological evaluation of childhood leukemia and paternal exposure to ionizing radiation included the INEEL site. This study found no evidence of a link between brain cancer or leukemia and paternal employment at INEEL (DOE and HHS 2000). Another study begun in October 1997, *Medical Surveillance for Former Workers at INEEL*, is being carried out by a group of investigators consisting of the Oil, Chemical, and Atomic Workers International Union; Mount Sinai School of Medicine; the University of Massachusetts at Lowell; and Alice Hamilton College. A mortality study of the work force at INEEL was conducted by the National Institute of Occupational Safety and Health. DOE has implemented an epidemiological surveillance program to monitor the health of current INEEL workers. A discussion of this program is given in Appendix M.4.4 of the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996g).

4.5.11.4 Accident History

DOE conducted a study, the *Idaho National Engineering Laboratory Historical Dose Evaluation*, to estimate the potential offsite radiation doses for the entire operating history of INEEL (DOE 1996g). Releases resulted from a variety of tests and experiments as well as a few accidents at INEEL. The study concluded that these releases contributed to the total radiation dose during test programs of the 1950s and early 1960s. The frequencies and sizes of releases have declined since that time. During more than the last decade of operations at INEEL facilities, there have been no serious unplanned or accidental releases of radioactivity or other hazardous substances.

4.5.11.5 Emergency Preparedness

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program was developed and is maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program includes emergency planning, training, preparedness, and response.

Government agencies whose plans are interrelated with the INEEL Emergency Plan for Action include the State of Idaho; Bingham, Bonneville, Butte, Clark, and Jefferson counties; the Bureau of Indian Affairs; and the Fort Hall Indian Reservation. INEEL contractors are responsible for responding to emergencies at their facilities. Specifically, the emergency action director is responsible for recognition, classification, notification, and protective action recommendations. At INEEL, emergency preparedness resources include fire protection from onsite and offsite locations and radiological and hazardous chemical material response. Emergency response facilities include an emergency control center at each facility, at the INEEL warning communication center, and at the INEEL site emergency operations center. Seven INEEL medical facilities are available to provide routine and emergency service. In addition, DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at Hanford in May 1997.

4.5.12 Waste Management

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies, and in compliance with all applicable Federal and state statutes and DOE Orders.

4.5.12.1 Waste Inventories and Activities

INEEL manages the following types of waste: high-level radioactive, transuranic, mixed transuranic, low-level radioactive, mixed low-level radioactive, hazardous, and nonhazardous. Because there are no high-level, transuranic, or mixed transuranic wastes associated with TA-18 operations, these waste types are not discussed in this EIS. Waste generation rates and the inventory of stored waste from activities at INEEL are provided in **Table 4–67**. INEEL waste management capabilities are summarized in **Table 4–68**.

Table 4–67 Waste Generation Rates and Inventories at INEEL

Waste Type	*Generation Rate (cubic meters per year)*	*Inventory (cubic meters)*
Low-level radioactive	6,400	6,000
Mixed low-level radioactive [a]	230	1,700
Hazardous	835 [b]	Not applicable [c]
Nonhazardous		
Liquid	2,000,000 [a]	Not applicable [c]
Solid	62,000	Not applicable [c]

[a] Projected annual average generation amounts for 1997–2006.
[b] Includes 760 cubic meters that is recyclable.
[c] Generally, hazardous and nonhazardous wastes are not held in long-term storage.
Source: DOE 2000k.

Table 4–68 Waste Management Facilities at INEEL

Facility Name/Description	*Capacity*	*Status*	*Applicable Waste Type*			
			Low-Level Radioactive Waste	*Mixed Low-Level Radioactive Waste*	*Hazardous*	*Non-hazardous*
Treatment Facility (cubic meters per year except as otherwise specified)						
INTEC HEPA Filter Leach (cubic meters per day)	0.21	Online		X		
INTEC Debris Treatment and Containment (cubic meters per day)	88	Waiting on Part B Permit		X		
Advanced Mixed Waste Treatment Project	6,500	Planned for 2003		X		
ANL-W Remote Treatment Facility	42	Planned for 2009	X	X		
INTEC Liquid Effluent Treatment and Disposal Facility	11,365	Online		X		
INTEC High-Level Radioactive Waste Evaporator	6,138	Online		X		
INTEC Process Equipment Waste Evaporator	13,000	Online	X	X		
ANL-W Sodium Processing Facility	698	Online		X		
Test Area North Cask Dismantlement	11	Online		X		
Test Reactor Area Evaporation Pond (cubic meters per day)	820	Online	X			
WROC-Debris Sizing (kilograms per hour)	1,149	Planned for 2000	X	X		
WROC-Macroencapsulation (kilograms per hour)	2,257	Planned for 2001		X		
WROC - Stabilization (cubic meters per day)	7.6	Online		X		

Facility Name/Description	Capacity	Status	Applicable Waste Type			
			Low-Level Radioactive Waste	Mixed Low-Level Radioactive Waste	Hazardous	Non-hazardous
WERF	49,610	Shutdown [a]	X	X	X	
INTEC Sewage Treatment Plant	3,200,000	Online				X
Storage Facility (cubic meters)						
ANL-W Radioactive Sodium Storage	75	Online		X		
ANL-W Sodium Components Maintenance Shop	200	Online		X		
ANL-W Radioactive Scrap and Waste Storage	193	Online	X	X		
ANL-W EBR II Sodium Boiler Drain Tank	64	Online		X		
INTEC FDPF HEPA Storage	25	Online		X		
INTEC NWCF HEPA Storage	56	Online		X		
INTEC CPP-1619 Storage	45	Online		X	X	
INTEC CPP-1617 Staging	8,523	Online		X	X	
RWMC Transuranic Storage Area-RE	64,900	Online	X	X		
RWMC Waste Storage [b]	112,400	Online	X	X		
WROC PBF Mixed Low-level Radioactive Waste Storage	129	Online		X	X	
Portable Storage at SPERT IV	237	Online		X	X	
PBF WERF Waste Storage Building	685	Online		X	X	
Test Area North 647 Waste Storage	104	Online		X		
Test Area North 628 SMC Container Storage	125	Online		X		
Disposal Facility (cubic meters per year)						
RWMC Disposal Facility	37,700	Online	X			
CFA Landfill Complex	48,000	Online				X
Percolation Ponds	2,000,000	Online				X
FPF Sanitary Sewer	166,000	Online				X
TRA Warm Waste Evaporation Ponds	31,830	Online	X			
TRA Sanitary Waste Ponds	51,720	Online				X
TRA Cold Waste Pond	795,800	Online				X

CFA = Central Facilities Area, CPP = Chemical Processing Plant, EBR = Experimental Breeder Reactor, FDPF = Fluorinel Dissolution Process Facility; FPF = Fuel Processing Facility, HEPA = high-efficiency particulate air, INTEC = Idaho Nuclear Technology and Engineering Center, PBF = Power Burst Facility; RWMC = Radioactive Waste Management Complex, SMC = Specific Manufacturing Complex, SPERT = Special Power Excursion Reactor Test, TRA = Test Reactor Area, WERF = Waste Experimental Reduction Facility, WROC = Waste Reduction Operations Complex.

[a] WERF was denied its RCRA permit and ceased operating in September 2000.

[b] For these facilities, the low-level radioactive and mixed low-level radioactive wastes are considered alpha-contaminated low-level radioactive waste and alpha-contaminated mixed low-level radioactive waste (waste containing between 10 and 100 nanocuries of alpha activity per gram).

Source: DOE 2000k.

EPA placed INEEL on the National Priorities List on December 21, 1989. In accordance with CERCLA, DOE entered into a consent order with EPA and the State of Idaho to coordinate cleanup activities at INEEL under one comprehensive strategy. This agreement integrates DOE's CERCLA response obligations with RCRA corrective action obligations. Aggressive plans are in place to achieve early remediation of sites that represent the greatest risk to workers and the public. The goal is to complete remediation of contaminated sites at INEEL to support delisting from the National Priorities List by 2019. More information on regulatory requirements for waste disposal is provided in Chapter 6.

4.5.12.2 Low-Level Radioactive Waste

Liquid low-level radioactive waste is solidified before disposal. Low-level radioactive waste disposal occurs in pits and concrete-lined soil vaults in the subsurface disposal area of the Radioactive Waste Management Complex. Approximately 60 percent of the low-level radioactive waste generated at INEEL is treated for volume reduction prior to disposal at the Radioactive Waste Management Complex. Additionally, some low-level radioactive waste is shipped off site to be incinerated, and the residual ash is returned to INEEL for disposal. The Radioactive Waste Management Complex is expected to be filled to capacity by the year 2030, although some proposals would close the low-level radioactive waste disposal facility by 2006.

4.5.12.3 Mixed Low-Level Radioactive Waste

Mixed low-level radioactive waste is divided into two categories for management purposes: alpha mixed low-level radioactive waste and beta-gamma mixed low-level radioactive waste. Most of the alpha mixed low-level radioactive waste stored at INEEL is waste that has been reclassified from mixed transuranic waste and is managed as part of the transuranic waste program. Therefore, this section deals only with beta-gamma mixed low-level radioactive waste.

Mixed low-level radioactive waste, including polychlorinated biphenyl–contaminated low-level radioactive waste, is stored at several onsite areas awaiting the development of treatment methods. Mixed low-level radioactive waste is stored at the Mixed Waste Storage Facility (or Waste Experimental Reduction Facility Waste Storage Building) and in portable storage units at the Power Burst Facility area. In addition, smaller quantities of mixed low-level radioactive waste are stored in various facilities at INEEL, including the Hazardous Chemical/Radioactive Waste Facility at the Idaho Nuclear Technology and Engineering Center, and the Radioactive Sodium Storage Facility and Radioactive Scrap and Waste Storage Facility at ANL-West. Although mixed wastes are stored in many locations at INEEL, the bulk of that volume is solid waste stored at the Radioactive Waste Management Complex.

As part of the INEEL Site Treatment Plan and Consent Order required by the Federal Facility Compliance Act, preferred treatment options have been identified to eliminate the hazardous waste component for many types of mixed low-level radioactive waste. Mixed low-level radioactive waste is or will be processed to RCRA land disposal restrictions treatment standards through several treatment facilities. Those treatment facilities and their operational status are: (1) Waste Experimental Reduction Facility Incinerator (shutdown), (2) Waste Experimental Reduction Facility Stabilization (operational), (3) Test Area North cask dismantlement (operational), (4) Sodium Process Facility (standby), (5) High-Efficiency Particulate Air Filter Leach (operational), (6) Waste Reductions Operations Complex Macroencapsulation (March 2001), (7) Debris Treatment (operational), and (8) Advanced Mixed Waste Treatment Project (March 2003). Commercial treatment facilities are also being considered, as appropriate. Currently, limited amounts of mixed low-level radioactive waste are disposed of at Envirocare of Utah.

4.5.12.4 Hazardous Waste

Approximately 1 percent of the total waste generated at INEEL (not including liquid nonhazardous waste) is hazardous waste. Most of the hazardous waste generated annually at INEEL is transported off site for treatment and disposal. Offsite shipments are surveyed to determine that the wastes have no radioactive content and, therefore, are not mixed waste. Highly reactive or unstable materials such as waste explosives are addressed on a case-by-case basis and are either stored, burned, or detonated, as appropriate.

4.5.12.5 Nonhazardous Waste

Approximately 90 percent of the solid waste generated at INEEL is classified as industrial waste and is disposed of on site in a landfill complex in the Central Facilities Area or off site at the Bonneville County landfill. The onsite landfill complex contains separate areas for petroleum-contaminated media, industrial waste, and asbestos waste. The onsite landfill is 4.8 hectares (12 acres), and is being expanded by 91 hectares (225 acres) to provide capacity for at least 30 years.

Sewage is disposed of in surface impoundments in accordance with terms of the October 7, 1992, Consent Order. Wastewater in the impoundments is allowed to evaporate, and the resulting sludge is placed in the landfill. Solids are separated and reclaimed where possible.

4.5.12.6 Waste Minimization

The DOE Idaho Operations Office has an active waste minimization and pollution prevention program to reduce the total amount of waste generated and disposed of at INEEL. This is accomplished by eliminating waste through source reduction or material substitution; by recycling potential waste materials that cannot be minimized or eliminated; and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. The Idaho Operations Office published its first Waste Minimization Plan in 1990, which defined specific goals, methodologies, responsibilities, and achievements of programs and organizations. Achievements and progress are updated at least annually. Implementation of pollution prevention projects reduced the total amount of waste generated at INEEL in 1999 by approximately 8,501 cubic meters (11,120 cubic yards). Examples of pollution prevention projects completed in 1999 at INEEL include: reduction of sanitary waste by approximately 6,467 metric tons (7,127 tons) by reusing or recycling concrete, steel, wood materials, etc., from deactivated and decommissioned buildings and equipment; and reduction of sanitary waste by 148 metric tons (163 tons) by reducing the total volume of office paper used at INEEL by 50 percent due to the use of electronic documents, electronic drawings, and e-mail (DOE 2000i).

4.5.12.7 Waste Management PEIS Records of Decision

The *Waste Management PEIS* Records of Decision affecting INEEL are shown in **Table 4–69**. Decisions on the various waste types were announced in a series of Records of Decision that have been published on the *Waste Management PEIS* (DOE 1997a). The hazardous waste Record of Decision was published on August 5, 1998 (63 FR 41810), and the low-level radioactive and mixed low-level radioactive waste Record of Decision was published on February 18, 2000 (65 FR 10061). The hazardous waste Record of Decision states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of their nonwastewater hazardous waste, and the Oak Ridge Reservation and the Savannah River Site will continue to treat some of their own nonwastewater hazardous waste on site in existing facilities, where this is economically feasible. The low-level radioactive waste and mixed low-level radioactive waste Record of Decision states that, for the management of low-level radioactive waste, minimal treatment will be performed at all sites and disposal will continue to the extent practicable on site at INEEL, LANL, the Oak Ridge Reservation, and the Savannah River Site. In addition, Hanford and NTS will be available to all DOE sites for low-level radioactive waste disposal. Mixed low-level radioactive waste will be treated at Hanford, INEEL, the Oak Ridge Reservation, and the Savannah River Site, and disposed of at Hanford and NTS. More detailed information concerning DOE's decisions for the future configuration of waste management facilities at INEEL is presented in the hazardous waste and low-level radioactive waste and mixed low-level radioactive waste Records of Decision.

Table 4–69 Waste Management PEIS Records of Decision Affecting INEEL

Waste Type	*Preferred Action*
Low-level radioactive	DOE has decided to treat INEEL's low-level radioactive waste on site. [a]
Mixed low-level radioactive	DOE has decided to regionalize treatment of mixed low-level radioactive waste at INEEL. This includes the onsite treatment of INEEL's wastes and could include treatment of some mixed low-level radioactive waste generated at other sites. [a]
Hazardous	DOE has decided to continue to use commercial facilities for treatment of INEEL nonwastewater hazardous waste. DOE will also continue to use onsite facilities for wastewater hazardous waste. [b]

[a] From the Record of Decision for low-level radioactive and mixed low-level radioactive waste (65 FR 10061).
[b] From the Record of Decision for hazardous waste (63 FR 41810).
Source: 63 FR 41810; 65 FR 10061.

CHAPTER 5

Environmental Impacts

TA-18

5. ENVIRONMENTAL IMPACTS

Chapter 5 describes the environmental consequences of the proposed action to relocate TA-18 capabilities and materials to either another location at Los Alamos National Laboratory or to Sandia National Laboratories/New Mexico, the Nevada Test Site, or Argonne National Laboratory-West. It also describes the environmental consequences of a No Action Alternative as well as the TA-18 Upgrade Alternative, under which TA-18 operations would continue at the Los Alamos National Laboratory TA-18 site. Site selection, affected environment, and environmental consequences associated with relocation of SHEBA and other security Category III/IV activities is presented as a separate analysis in this chapter. Chapter 5 also describes the environmental consequences of decontamination and decommissioning, impacts common to all alternatives, mitigation measures, and resource commitments.

5.1 INTRODUCTION

The environmental impacts analysis addresses all potentially affected areas in a manner commensurate with the importance of the effects on each area. The methodologies used for preparing the assessments for the following resource areas are discussed in Appendix F of this environmental impact statement (EIS): land resources; site infrastructure; air quality; noise; geology and soils; water resources; ecological resources; cultural and paleontological resources; socioeconomics; and waste management. The methodologies used to assess the human health effects from normal operations, facility accidents, and transportation are presented in Appendices B, C, and D, respectively. The environmental justice methodology is presented in Appendix E.

With the exception of the No Action Alternative, all alternatives would involve various degrees of construction activities. All construction would take place on land already owned by the Federal Government and administered by the U.S. Department of Energy (DOE) and, for a number of alternatives, on land that has already been disturbed by other DOE activities. This *Draft Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (*TA-18 Relocation EIS*) addresses in detail the effects usually associated with land disturbance that construction activities would have on air and water resources and in lesser detail the effects on ecological, historical, cultural, and paleontological resources.

As indicated in Section 3.2.1, the normal operations activities under the proposed action would not be characterized by any significant release of effluent, radiological or nonradiological, hazardous or nonhazardous. Therefore, the effects on the health and safety of workers, the public, and the environment from normal facility operations are presented in detail in deference to public interest rather than an indication of their significance. This is also true of the assessments presented for socioeconomics, environmental justice, and waste generation.

The effects on the health and safety of workers, the public, and the environment from postulated accident conditions are presented in detail. The accidents selected for evaluation in this EIS are a subset of accidents that have been evaluated in detail and described in the *Basis for Interim Operations for the Los Alamos Critical Experiments Facility and Hillside Vault* (*TA-18 BIO*) (DOE 2001a). The accidents include a spectrum of events caused by fire, explosion, criticality, natural phenomena (i.e., earthquake), and external event (i.e., aircraft crash). Currently, DOE is considering impacts from sabotage in a separate analysis. Once complete, this analysis will be incorporated as a classified appendix in the final EIS. Specific discussions

Radiological Health Effects Risk Factors Used in this EIS

Health impacts of radiation exposure, whether from external or internal sources, are generally identified as "somatic" (i.e., affecting the exposed individual) or "genetic" (i.e., affecting descendants of the exposed individual). Radiation is more likely to produce somatic effects (i.e., induced cancers) than genetic effects. 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. Because of the delayed effect, the cancers are referred to as "latent" cancers.

For a uniform irradiation of the body, the incidence of cancer varies among organs and tissues; the thyroid gland and skin demonstrate a greater sensitivity than other organs. Such cancers, however, also produce comparatively low mortality rates because they are relatively amenable to medical treatment. Because fatal cancer is the most probable serious effect of environmental and occupational radiation exposure, estimates of cancer fatalities, rather than cancer incidents, are presented in this EIS.

The number of latent cancer fatalities is estimated using risk factors determined by the International Commission on Radiological Protection. A risk factor is the probability that an individual would incur a latent cancer fatality during his or her lifetime if the individual receives a unit of radiation dose (1 rem). The risk factor for workers would be 0.0004 (latent cancer fatalities per rem) and 0.0005 (latent cancer fatalities per rem) for individuals among the general public. The risk factor for the public would be slightly higher because the public includes infants and children, who are more sensitive to radiation than adults.

Examples:

> The latent cancer fatality risk for an individual (nonworker) receiving a dose of 0.1 rem would be 0.00005 (0.1 rem × 0.0005 latent cancer fatalities per rem). This risk can also be expressed as 0.005 percent chance or 1 chance in 20,000.
>
> The same concept is used to calculate the latent cancer fatality risk from exposing a group of individuals to radiation. The latent cancer fatality risk for individuals in a group of 100,000, each receiving a dose of 0.1 rem, would be 0.00005, as indicated above. This individual risk, multiplied by the number of individuals in the group, expresses the number of latent cancer fatalities that could occur among the individuals in the group. In this example, the number would be 5 latent cancer fatalities (100,000 × 0.00005). A number of latent cancer fatalities less than 1 means that the radiation exposure is not sufficient to cause a single latent cancer fatality among the members of the group. In this case, the risk is expressed as a probability that a single latent cancer fatality would occur among the members of the group. For example, 0.05 latent cancer fatalities can be stated as "there is 1 chance in 20 (1/0.05) that 1 latent cancer fatality would occur among the members of the group."

The EIS provides estimates of probability of a latent cancer fatality occurring for the involved and noninvolved workers, the maximally exposed offsite individual, an average individual, and the general population. These categories are defined as follows:

Involved worker—An individual worker participating in the operation of the facilities

Noninvolved worker—An individual worker at the site other than the involved worker

Maximally exposed offsite individual—A hypothetical member of the public residing at the site boundary who could receive the maximum dose of radiation or exposure to hazardous chemicals

Average individual—A member of the public receiving an average dose of radiation or exposure to hazardous chemicals

Population—Members of the public residing within an 80-kilometer (50-mile) radius of the facility.

associated with the descriptions of existing and proposed facilities for the relocation of the TA-18 missions and the assumptions used for the health and safety impact assessments are presented in appendices as follows:

Appendix A, Critical Assembly Descriptions
Appendix B, Human Health Effects from Normal Operations
Appendix C, Human Health Effects from Facility Accidents
Appendix D, Human Health Effects from Transportation
Appendix E, Environmental Justice

Chapter 5 is organized by major sections devoted to each site. Section 5.2 discusses the environmental consequences at the Los Alamos National Laboratory (LANL). LANL is involved in the No Action Alternative, the TA-18 Upgrade Alternative, and the LANL New Facility Alternative. The section includes discussion of impacts on all environmental resources for these three alternatives, impacts due to intersite transportation, and cumulative impacts at LANL. Sections 5.3, 5.4, and 5.5 discuss the environmental consequences of relocating TA-18 capabilities and materials to Sandia National Laboratories/New Mexico (SNL/NM), the Nevada Test Site (NTS), and Argonne National Laboratory-West (ANL-W), respectively. In addition to the discussion of construction and operations impacts on all environmental resources associated with each site, each section includes the impacts from transportation activities from LANL to the respective relocation site and the potential cumulative impacts that could result at each of these sites.

Additional sections in Chapter 5 present issues and impacts common to all or some of the alternatives. These sections include:

Section 5.6 Relocation of SHEBA and other security Category III/IV activities—Discusses the relocation of the TA-18 Solution High-Energy Burst Assembly (SHEBA) and other security Category III/IV activities. As discussed in Section 3.2, these TA-18 activities would not move out of LANL regardless of the alternative implemented for security Category I/II activities. Site selection, affected environment, options, and impacts associated with these activities are presented separately for convenience. The impacts are common and additive to each of the site alternatives except the No Action and the TA-18 Upgrade Alternatives.

Section 5.7 Decontamination and Decommissioning—Discusses generically and qualitatively the issue of decontamination and decommissioning for the existing TA-18 facilities after relocation and for the proposed new relocation facilities at the end of operations.

Section 5.8 Impacts Common to All Alternatives—Discusses impacts common to all alternatives in addition to those associated with SHEBA and security Category III/IV activities.

Section 5.9 Mitigation Measures—Discusses mitigation measures.

Section 5.10 Resource Commitments—Discusses, in general, the resource commitments required for the proposed action including unavoidable adverse impacts, the relationship between short-term and long-term use, and irreversible/irretrievable commitment of resources.

5.2 LANL ALTERNATIVES

This section presents a discussion of the environmental impacts associated with the No Action Alternative, the TA-18 Upgrade Alternative, and the LANL New Facility Alternative.

Under the No Action Alternative, the current operations at TA-18, involving all security Category activities, would be maintained at their current location in accordance with the Expanded Operations Alternative (Preferred Alternative) described in the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory (LANL SWEIS)* (DOE 1999b) and associated Record of Decision (64 FR 50797). The No Action Alternative represents the status quo and would involve no new construction or any internal modifications other than those described in the *LANL SWEIS*.

Under the TA-18 Upgrade Alternative, the current operations at TA-18, involving all security Category activities, would remain at TA-18. Upgrade activities would involve internal modifications to existing facilities, infrastructure upgrades, and some new construction, as previously described in Section 3.3.2.

Under the LANL New Facility Alternative, the current operations at TA-18, involving all security Category activities except SHEBA, would be relocated to new buildings at TA-55 at LANL. SHEBA would be relocated to new structures at LANL's TA-39.

The environmental impacts associated with the LANL alternatives are presented below for each environmental resource area. Environmental impacts associated with the relocation of SHEBA and security Category III/IV activities are discussed separately in Section 5.6. The Expanded Operations Alternative presented in the *LANL SWEIS* provides the baseline from which incremental effects of the proposed action at LANL are measured.

5.2.1 Land Resources

5.2.1.1 Land Use

No Action Alternative

Under the No Action Alternative, TA-18 operational capabilities and material storage would continue at the level described in the *LANL SWEIS*. Since no new buildings or facilities would be built and operations would not change, there would be no impact on land use at the site.

TA-18 Upgrade Alternative

Construction Impacts—With the exception of a new dome warehouse, all new facilities associated with this alternative would be built within the current TA-18 limited-area fence. The new dome warehouse would be built to the west of Building 30 and would require relocation of the limited-area fence. Construction of this facility would disturb about 0.2 hectares (0.5 acres) of previously cleared land. In addition to new construction, several existing structures would be modified. Both new construction and modifications to existing buildings required under this alternative would be compatible with the current land use at TA-18 and with its present Research and Development land-use designation (see Section 4.2.1.1).

Operations Impacts—Operations of new and upgraded facilities at TA-18 would be compatible with the current land use at TA-18, as well as its present land-use designation. Thus, there would be no impact on land use during the operational phase of the proposed action.

LANL New Facility Alternative

Construction Impacts—Under this alternative, a new below-grade critical assembly facility building and three new aboveground buildings (i.e., Central Utility Building, Low-Scatter Building, and Protected-Area Access-Control Building) would be constructed on 1.8 hectares (4.5 acres) of land. These new buildings would be located to the northwest of Plutonium Facility 4. Although use of the area for relocated TA-18 operations represents a change in land use of the area to be developed, its development is compatible with the area's current Research and Development land-use designation.

Operations Impacts—Operations of facilities at TA-55 would be compatible with current land use at TA-55, as well as its present land-use designation. Thus, there would be no impact on land use during the operational phase of the proposed action.

5.2.1.2 Visual Resources

No Action Alternative

Under the No Action Alternative, there would be no impact on visual resources at LANL or TA-18 since no new facilities would be built.

TA-18 Upgrade Alternative

Construction Impacts—Activities related to the construction of new buildings and building modifications required for the TA-18 Upgrade Alternative would result in a change to the visual appearance of the TA-18 area due to the presence of construction equipment and possibly increased dust. These changes would be temporary and, because of the isolated location of the area, would not be noticeable from any location beyond the LANL boundary. Thus, impacts on visual resources during construction would be minimal.

Operations Impacts—The new dome warehouse would slightly change the appearance of TA-18. However, this change would be consistent with current development in the area and, as noted above, would not be visible by the public from off site. Internal modifications to TA-18 structures would not result in any change to the appearance of the site. Thus, neither new construction nor modifications at TA-18 would change the current Class IV Bureau of Land Management Visual Resource Management rating of the area.

LANL New Facility Alternative

Construction Impacts—Under this alternative, a new below-grade critical assembly facility building and three new aboveground buildings would be constructed at TA-55. These facilities would be located to the northwest of Plutonium Facility 4. Construction impacts related to the presence of construction equipment and possibly increased dust would be temporary and generally would not be noticeable from off site.

Operations Impacts—New buildings would add to the visual impact of development at TA-55. However, the impact of the critical assembly facility building would be minimal since it would be built mostly underground. While not visible from lower elevations, new construction would be visible from higher elevations to the west along the upper reaches of the Pajarito Plateau rim. As a result of the Cerro Grande Fire, visibility of newly built structures (as well as the entire TA-55 area) would be greater than it would have been before the fire. However, regardless of the effects of the fire, the Class IV Bureau of Land Management Visual Resource Management rating of the area would not change as a result of implementation of this alternative.

5.2.2 Site Infrastructure

Annual site infrastructure requirements for current LANL operations as well as current site infrastructure capacities are presented in **Table 5–1**. These values provide the baseline for the LANL site infrastructure impact analyses presented hereafter in this section. The table also presents projected site infrastructure requirements that incorporate both the forecasted demands of the *LANL SWEIS* Expanded Operations Alternative and those of non-LANL users relying on the same utility systems. The *LANL SWEIS* identified that peak electrical demand could exceed site electrical capacity. In addition, whereas the *LANL SWEIS* had projected that water use would remain within DOE water rights, LANL now ultimately plans to permanently convey 70 percent of its water rights to Los Alamos County, lease the remaining 30 percent, and retain the right to purchase the leased percentage. As a result, site electric peak load and water capacities could also be exceeded at LANL in the future, even in the absence of new demands, should projected site requirements be realized. However, no infrastructure capacity constraints are anticipated in the near term, as LANL operational demands to date on key infrastructure resources (i.e., natural gas, water, and electricity) have been well below projected levels and well within the site capacities shown in Table 5–1. Also, no constraints in association with relocation of TA-18 operations are projected. DOE continues to evaluate options for increasing the reliability and availability of electric power to LANL (see Section 4.2.2.2) and purchase additional water from the county, if needed and available. Any potential shortfalls in available capacity would be addressed as increased site requirements are realized.

Table 5–1 Current and Projected Site Infrastructure Requirements for LANL Operations

Resource	*Site Capacity*	*Current Site Requirement* [a]	*Projected Site Requirement*	*Potential Exceeded Capacity*
Electricity [b]				
Energy (megawatt-hours per year)	937,000	475,868	876,000	0
Peak load (megawatts)	107	83	127	20
Fuel				
Natural gas (cubic meters per year)	229,400,000	70,000,000	81,600,000	0
Liquid fuels (liters per year) [c]	Not limited	Negligible	Negligible	0
Coal (metric tons per year)	Not applicable	0	0	0
Water (liters per year)	2,050,000,000 [d]	1,715,000,000	2,900,000,000	850,000,000

[a] Projected requirements over 25 years under the *LANL SWEIS* Expanded Operations Alternative (DOE 1999b). Revised projections for electrical energy, peak load, and natural gas also include usage for other Los Alamos County users that rely upon the same utility system (DOE 1999h).

[b] Electrical site capacity and current requirements are for the entire Los Alamos Power Pool, which includes LANL and other Los Alamos County users.

[c] Not limited due to offsite procurement.

[d] Equivalent to 30 percent of the water-right allocation from the main aquifer.

Source: Table 4–2, *TA-18 Relocation EIS*.

No Action Alternative

Projected site infrastructure requirements of TA-18 operations under the No Action Alternative are presented in **Table 5–2**. TA-18 operations consume a relatively small percentage of current available site capacities for electricity and water, with operations under the No Action Alternative essentially reflecting a continuation of current activities. Thus, the net impact on infrastructure is expected to be negligible.

TA-18 Upgrade Alternative

Construction Impacts—The projected demands on key site infrastructure resources associated with site construction under this alternative on an annual basis are presented in **Table 5–3**. Existing LANL infrastructure would easily be capable of supporting the construction requirements under the TA-18 Upgrade Alternative without exceeding current site capacities. The electrical distribution and potable-water piping systems would be upgraded and replaced to better serve the upgraded facilities. Although gasoline and diesel fuel would be required to operate construction vehicles, generators, and other construction equipment, it is expected that fuel would be procured from offsite sources and, therefore, would not be a limited resource. Impacts on the local transportation network are expected to be negligible.

Table 5–2 Annual Site Infrastructure Requirements for LANL Operations under the No Action Alternative

Resource	*Available Site Capacity* [a]	*No Action Alternative Requirement* [b]	*Percent of Available Site Capacity*
Electricity			
Energy (megawatt-hours per year)	461,132	2,836	0.6
Peak load (megawatts)	24	0.39	1.6
Fuel			
Natural gas (cubic meters per year)	159,400,000	200	0.0001
Liquid fuels (liters per year)[c]	Not limited	Negligible	Not limited
Coal (metric tons per year)	Not applicable	0	Not applicable
Water (liters per year)	335,000,000	14,650,000 [d]	4.4

[a] Capacity minus the current site requirements, a calculation based on the data provided in Table 5–1, *TA-18 Relocation EIS*.
[b] The No Action Alternative is a continuation of current TA-18 activities, and, therefore, associated infrastructure requirements are already accounted for in the "Available Site Capacity."
[c] Not limited due to offsite procurement.
[d] Estimated value.
Sources: Table 5–1, *TA-18 Relocation EIS*; LANL 2001a.

Table 5–3 Annual Site Infrastructure Requirements for Facility Construction under the TA-18 Upgrade and LANL New Facility Alternatives

Resource	*Available Site Capacity* [a]	*TA-18 Upgrade Alternative*		*LANL New Facility Alternative*	
		Requirement	*Percent of Available Site Capacity*	*Requirement*	*Percent of Available Site Capacity*
Electricity					
Energy (megawatt-hours per year)	461,132	187	0.04	128	0.03
Peak load (megawatts)	24	0.2	0.8	0.13	0.5
Fuel					
Natural gas (cubic meters per year)	159,400,000	0	0	0	0
Gasoline and diesel fuel (liters per year) [b]	Not limited	Negligible	Not limited	Negligible	Not limited
Water (liters per year)	335,000,000	2,900,000	0.9	17,000,000	5.1

[a] Capacity minus the current site requirements, a calculation based on the data provided in Table 5–1, *TA-18 Relocation EIS*.
[b] Not limited due to offsite procurement.
Sources: Table 5–1, *TA-18 Relocation EIS*; LANL 2001a.

Operations Impacts—Resources needed to support facility operations under the TA-18 Upgrade Alternative are presented in **Table 5–4**. Given current available site capacities, it is projected that existing LANL infrastructure resources would be adequate to support the proposed activities over 25 years.

LANL New Facility Alternative

Construction Impacts—It is projected that the existing LANL infrastructure would be capable of supporting construction requirements under the LANL New Facility Alternative on an annual basis without exceeding current site capacities (see Table 5–3). Impacts on the local transportation network are expected to be negligible.

Operations Impacts—Resources needed to support operations under the LANL New Facility Alternative are presented in Table 5–4. It is projected that existing LANL infrastructure resources would be adequate to support proposed TA-18 activities over 25 years, based on current infrastructure demand.

Table 5–4 Annual Site Infrastructure Requirements for Facility Operations under the TA-18 Upgrade and LANL New Facility Alternatives

Resource	Available Site Capacity [a]	TA-18 Upgrade Alternative		LANL New Facility Alternative [b]	
		Requirement	Percent of Available Site Capacity	Requirement	Percent of Available Capacity
Electricity					
Energy (megawatt-hours per year)	461,132	2,836	0.6	21,000	4.6
Peak load (megawatts)	24	0.39	1.6	3	12.5
Fuel					
Natural gas (cubic meters per year)	159,400,000	200	0.0001	1,300,000	0.8
Liquid fuels (liters per year) [c]	Not limited	Negligible	Not limited	Negligible	Not limited
Coal (metric tons per year)	Not applicable	0	Not applicable	0	Not applicable
Water (liters per year)	335,000,000	14,650,000	4.4	6,900,000	2.1

[a] Capacity minus the current site requirements, a calculation based on the data provided in Table 5–1, *TA-18 Relocation EIS*.
[b] The actual net requirement for each resource would be the difference between that under the LANL New Facility Alternative minus that projected for the TA-18 Upgrade Alternative.
[c] Not limited due to offsite procurement.
Sources: Table 5–1, *TA-18 Relocation EIS*; LANL 2001a.

5.2.3 Air Quality

5.2.3.1 Nonradiological Releases

No Action Alternative

Under the No Action Alternative, small quantities of criteria and toxic air pollutants would continue to be generated from the burning of fuels (e.g., natural gas, propane, etc.) and other activities at TA-18. The emissions generated are considered part of the baseline concentrations (see Table 4–5). No increases in emissions or air pollutant concentrations are expected under the No Action Alternative. Therefore, a Prevention of Significant Deterioration increment analysis is not required (See Appendix F, Section F.3.1). In addition, LANL is located in an attainment area for criteria air pollutants; therefore, no conformity analysis is required (See Appendix F, Section F.3.2).

TA-18 Upgrade Alternative

Construction Impacts—Construction of new structures and modification of existing structures at TA-18 would result in temporary increases in air quality impacts from construction equipment, trucks, and employee vehicles. Criteria pollutant concentrations for construction were modeled and compared to the most stringent standards (see **Table 5–5**). The maximum ground-level concentrations that would result from construction would be below the ambient air quality standards. The maximum short-term concentrations would occur at receptors on Pajarito Road adjacent to the construction area. The maximum annual concentrations would occur at a receptor to the east of TA-54 along the LANL boundary. Modeling of construction air quality considered particulate emissions from activity in a construction area of 0.2 hectares (0.5 acres) and emissions from various earthmoving and material-handling equipment.

Table 5–5 Nonradiological Air Quality Concentrations at the Site Boundary under the TA-18 Upgrade Alternative – Construction

	Averaging Period	*Most Stringent Standard or Guideline (micrograms per cubic meter)* [a]	*Maximum Incremental Concentration (micrograms per cubic meter)* [b]
Carbon monoxide	8 Hours 1 Hour	7,800 11,700	171 1,370
Nitrogen dioxide	Annual 24 Hours	73.7 147	0.242 73.9
PM_{10}	Annual 24 Hours	50 150	0.078 26.5
Sulfur dioxide	Annual 24 Hours 3 Hours	41 205 1,030	0.02 6.98 55.8
Total suspended particulates	Annual 24 Hours	60 150	0.138 46.5

PM_{10} = particulate matter less than or equal to 10 microns in diameter.

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean PM_{10} standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard. Standards and monitored values for pollutants other than particulate matter are stated in parts per million. These values have been converted to micrograms per cubic meter with appropriate corrections for temperature (21° C [70° F]) and pressure (elevation 2,135 meters [7,005 feet]), following New Mexico dispersion modeling guidelines (revised 1998) (NMAQB 1998).

[b] The annual concentrations were analyzed at locations to which the public has access—the site boundary and nearby sensitive areas. Short-term concentrations were analyzed at the site boundary and at the fence line of the technical area to which the public has short-term access.

Sources: DOE 1999b, LANL 2001a.

Operations Impacts—Under the TA-18 Upgrade Alternative, small quantities of criteria and toxic air pollutants would continue to be generated from the burning of fuels such as natural gas and propane. The emissions are independent of the activities being performed at TA-18. The emissions are considered part of the baseline concentrations (see Table 4–5). No increases in air pollutant emissions or concentrations are expected under this alternative. Therefore, a Prevention of Significant Deterioration increment analysis is not required (see Appendix F, Section F.3.1). In addition, LANL is located in an attainment area for criteria pollutants; therefore, no conformity analysis is required (see Appendix F, Section F.3.2).

LANL New Facility Alternative

Construction Impacts—Construction of new buildings at TA-55 would result in an increase in air quality impacts from construction equipment, trucks, and employee vehicles. Criteria pollutant concentrations for construction were modeled and compared to the most stringent standards (see **Table 5–6**). The maximum ground-level concentrations that would result from construction would be below the ambient air quality standards, except for short-term concentrations of total suspended particulates which could be above the standard at receptors adjacent to the site along Pajarito Road. Actual construction concentrations are expected to be less, since conservative emission factors and other assumptions were used in the modeling of construction activities and tend to overestimate impacts. The maximum short-term concentrations occur at a receptor on Pajarito Road adjacent to the construction area. The maximum annual concentrations would occur at a receptor to the north of TA-55 along the LANL boundary. Modeling of construction air quality considered particulate emissions from activity in a construction area of 1.8 hectares (4.5 acres) for security Category I/II activities and emissions from various earthmoving and material-handling equipment. Mitigation measures that could be applied to construction activities are discussed in Section 5.9.

Table 5–6 Nonradiological Air Quality Concentrations at the Site Boundary under the LANL New Facility Alternative – Construction

	Averaging Period	*Most Stringent Standard or Guideline (micrograms per cubic meter)* [a]	*Maximum Incremental Concentration from TA-55 (micrograms per cubic meter)* [b]
Carbon monoxide	8 Hours	7,800	30.3
	1 Hour	11,700	132
Nitrogen dioxide	Annual	73.7	0.32
	24 Hours	147	33
PM_{10}	Annual	50	1.98
	24 Hours	150	129
Sulfur dioxide	Annual	41	0.029
	24 Hours	205	3.31
	3 Hours	1,030	24.8
Total suspended particulates	Annual	60	3.93
	24 Hours	150	254

PM_{10} = particulate matter less than or equal to 10 microns in diameter.

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean PM_{10} standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard. Standards and monitored values for pollutants other than particulate matter are stated in parts per million. These values have been converted to micrograms per cubic meter with appropriate corrections for temperature (21 °C [70 °F]) and pressure (elevation 2,135 meters [7,005 feet]), following New Mexico dispersion modeling guidelines (revised 1998) (NMAQB 1998).

[b] The annual concentrations were analyzed at locations to which the public has access – the site boundary and nearby sensitive areas. Short-term concentrations were analyzed at the site boundary and at the fence line of the technical area to which the public has short-term access.

Sources: DOE 1999b, LANL 2001a.

Operations Impacts—Under the LANL New Facility Alternative, criteria and toxic pollutants would be generated from the operation of the emergency diesel generators and other activities at TA-55. The emissions from the generators would be independent of the activities being performed at TA-55, since they result primarily from periodic testing. **Table 5–7** summarizes the concentrations of criteria pollutants from operation of the diesel generators. The concentrations are compared to their corresponding ambient air quality standards. The maximum ground-level concentrations that would result from operations would be below the ambient air quality standards, except for 24-hour standards for nitrogen dioxide. Actual operation concentrations are expected to be less because conservative stack parameters were assumed in the modeling of the diesel generator. The maximum annual concentrations would occur at a receptor to the north of TA-55 along the LANL boundary. The maximum short-term concentrations would occur at a receptor on Pajarito Road adjacent to TA-55. Mitigation measures that could be applied to operation activities are discussed in Section 5.9. No major change in emissions or air pollutant concentrations are expected under this alternative. Therefore, a Prevention of Significant Deterioration increment analysis is not required (see Appendix F, Section F.3.1). In addition, LANL is located in an attainment area for criteria air pollutants; therefore, no conformity analysis is required (see Appendix F, Section F.3.2).

5.2.3.2 Radiological Releases

No Action Alternative

Construction Impacts—There would be no radiological releases to the environment because this alternative would not involve any construction.

Table 5–7 Nonradiological Air Quality Concentrations at the Site Boundary under the LANL New Facility Alternative – Operations

	Averaging Period	*Most Stringent Standard or Guideline (micrograms per cubic meter)* [a]	*Maximum Incremental Concentration (micrograms per cubic meter)* [b]
Carbon monoxide	8 Hours 1 Hour	7,800 11,700	682 2,980
Nitrogen dioxide	Annual 24 Hours	73.7 147	0.061[c] 668[c]
PM_{10}	Annual 24 Hours	50 150	0.002 20.6
Sulfur dioxide	Annual 24 Hours 3 Hours	41 205 1,030	0.015 166 751
Total suspended particulates	Annual 24 Hours	60 150	0.002 20.6

PM_{10} = particulate matter less than or equal to 10 microns in diameter.

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean PM_{10} standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard. Standards and monitored values for pollutants other than particulate matter are stated in parts per million. These values have been converted to micrograms per cubic meter with appropriate corrections for temperature (21 °C [70 °F]) and pressure (elevation 2,135 meters [7,005 feet]), following New Mexico dispersion modeling guidelines (revised 1998) (NMAQB 1998).

[b] The annual concentrations were analyzed at locations to which the public has access – the site boundary and nearby sensitive areas. Short-term concentrations were analyzed at the site boundary and at the fence line of the technical area to which the public has short-term access.

[c] Actual concentration is expected to be less because conservative stack parameters were used in the modeling of diesel generator emissions.

Sources: DOE 1999b, LANL 2001a.

Operations Impacts—Approximately 110 curies per year of argon-41 would be released to the environment from operations of the TA-18 facilities at LANL. There would be no other radiological releases. Impacts from radiological releases are discussed in Section 5.2.10.1.

TA-18 Upgrade Alternative

Construction Impacts—While no radiological releases to the environment are expected in association with construction activities at TA-18, the potential exists for contaminated soils and possibly other media to be disturbed during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any contamination and would be required to remediate any contamination in accordance with procedures established under LANL's environmental restoration program and in accordance with LANL's Hazardous Waste Facility Permit.

Operations Impacts—Approximately 110 curies per year of argon-41 would be released to the environment from the operations of the TA-18 facilities at LANL. There would be no other radiological releases. Impacts from radiological releases are discussed in Section 5.2.10.1.

LANL New Facility Alternative

Construction Impacts—While no radiological releases to the environment are expected in association with construction activities at TA-55, the potential exists for contaminated soils and possibly other media to be disturbed during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any contamination and would be required to remediate any contamination in accordance with procedures established under LANL's environmental restoration program and in accordance with LANL's Hazardous Waste Facility Permit.

Operations Impacts—Approximately 10 curies per year of argon-41 would be released to the environment from the operations of the relocated TA-18 capabilities at the new buildings in TA-55 (see Section 3.2.1). Impacts from radiological releases are discussed in Section 5.2.10.1.

5.2.4 Noise

No Action Alternative

Continuing operations at TA-18 would not involve any new construction, major changes in activities, or changes in employment levels. Thus, there would be no change in noise impacts on wildlife around the area or on the public under the No Action Alternative.

TA-18 Upgrade Alternative

Construction Impacts—Construction of new buildings and modification of facilities at TA-18 would result in some temporary increase in noise levels near the area from construction equipment and activities. Some disturbance of wildlife near the area may occur as a result of operation of construction equipment. There would be no change in noise impacts on the public outside of LANL as a result of construction activities, except for a small increase in traffic noise levels from construction employees and material shipments. Noise sources associated with construction at TA-18 are not expected to include loud impulsive sources such as blasting.

Operations Impacts—Noise impacts from operations of the upgraded TA-18 facilities are expected to be unchanged from existing operations at TA-18.

LANL New Facility Alternative

Construction Impacts—Construction of new buildings at TA-55 would result in some temporary increase in noise levels near the area from construction equipment and activities. Some disturbance of wildlife near the area may occur as a result of operation of construction equipment. There would be no change in noise impacts on the public as a result of construction activities, except for a small increase in traffic noise levels from construction employees and material shipments. Noise sources associated with construction at TA-55 are not expected to include loud impulsive sources such as blasting.

Operations Impacts—Noise impacts from operations at the new buildings within TA-55 are expected to be similar to those from existing operations at TA-55. Although there would be a small increase in traffic and equipment noise (e.g., heating and cooling systems and generators) near the area, there would be little change in noise impacts on wildlife and no change in noise impacts on the public outside of LANL as a result of moving these activities to TA-55.

5.2.5 Geology and Soils

No Action Alternative

No additional impacts on geology and soils are anticipated at LANL beyond the effects of existing and projected activities independent of this proposed action. Hazards from large-scale geologic conditions, such as earthquakes, and from other site geologic conditions with the potential to affect existing LANL facilities are summarized in Section 4.2.5 and further detailed in the *LANL SWEIS* (DOE 1999b).

TA-18 Upgrade Alternative

Construction Impacts—Construction associated with mission relocation activities under the TA-18 Upgrade Alternative is expected to disturb a total of approximately 0.2 hectares (0.5 acres) of land adjacent to existing facilities at the Pajarito site. Aggregate and other geologic resources (e.g., sand) would be required to support construction activities at TA-18, but these resources are abundant in Los Alamos County. In addition to new facility construction and upgrades, excavation to remove and replace some existing utility systems would also be conducted. However, as blasting should not be necessary and the land area to be disturbed is relatively small, the impact on geologic and soil resources would be relatively minor. A site survey and foundation study would be conducted as necessary to confirm site geologic characteristics for facility engineering purposes. The potential also exists for contaminated soils and possibly other media to be encountered during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any contaminated media and required remediation in accordance with the procedures established under the site's environmental restoration program and in accordance with LANL's Hazardous Waste Facility Permit.

As discussed in Section 4.2.5, LANL is located in a region of low to moderate seismicity overall. Ground shaking of Modified Mercalli Intensity VII (see Appendix F, Table F–6) associated with postulated earthquakes is possible and supported by the historical record for the region. Modified Mercalli Intensity VII would be expected to affect primarily the integrity of inadequately designed or nonreinforced structures, but damage to properly or specially designed or upgraded facilities would not be expected. Nevertheless, a capable fault (Rendija Canyon) is located about 5.5 kilometers (3.3 miles) northwest of TA-18. The potential for other large-scale geologic hazards to affect TA-18 facilities is generally low.

As stated in DOE Order 420.1, DOE is required to ensure that nuclear and nonnuclear facilities be designed, constructed, and operated so that workers, the public, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes.

Operations Impacts—The operations of TA-18 facilities under the TA-18 Upgrade Alternative would not be expected to result in impacts on geologic and soil resources at LANL. As discussed above, new, upgraded, and modified facilities would be evaluated, designed, and constructed in accordance with DOE Order 420.1 and sited to minimize the risk from geologic hazards. Thus, site geologic conditions would not likely affect the facilities.

LANL New Facility Alternative

Construction Impacts—Construction associated with mission relocation activities under the LANL New Facility Alternative is expected to disturb a total of approximately 1.8 hectares (4.5 acres) of land northwest of Plutonium Facility 4 at TA-55. Aggregate and other geologic resources (e.g., sand) would be required to support construction activities at TA-18, but these resources are abundant in Los Alamos County. Relatively deep excavation would be required to construct below-grade portions of the critical assembly bays and material vaults, although no blasting is expected to be required. However, construction and excavation of volcanic tuff and overlying soils would have the potential to disturb contaminated media from a potential release site attributed to TA-48 activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any contaminated media and required remediation in accordance with the procedures established under the site's environmental restoration program and in accordance with LANL's Hazardous Waste Facility Permit.

Geologic hazards at LANL are discussed in detail in Section 4.2.5; the threat to LANL facilities is discussed previously for the TA-18 Upgrade Alternative. The Rendija Canyon Fault terminates approximately 1.3 kilometers (0.8 miles) northwest of TA-55. New facilities proposed under this alternative would be designed and constructed in accordance with applicable DOE orders and standards to ensure that workers, the public, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes.

Operations Impacts—The operations of the new facilities to support relocated TA-18 security Category I and II operational capabilities at TA-55 under this alternative would not be expected to result in impacts on geologic and soil resources at LANL. New facilities would be designed and constructed in accordance with applicable DOE orders and standards to minimize the risk from geologic hazards. Thus, site geologic conditions would be unlikely to affect the facilities over the 25-year operational life expectancy.

5.2.6 Water Resources

5.2.6.1 Surface Water

No Action Alternative

No additional impacts on surface water resources are anticipated at LANL under the No Action Alternative beyond the effects of existing and projected activities described in the Expanded Operations Alternative of the *LANL SWEIS* (DOE 1999b), which are independent of this proposed action.

TA-18 Upgrade Alternative

Construction Impacts—Surface water would not be used to support the construction of upgraded facilities at TA-18. Groundwater is the source of water at LANL. The Pajarito Canyon arroyo, which traverses the TA-18 complex, is not perennial and is not a viable source of surface water. Therefore, there would be no construction impact on surface water availability. Sanitary wastewater would be generated by construction personnel. As plans include the use of portable toilets, there would be no onsite discharge of sanitary wastewater and no impact on surface waters. Waste generation and management activities are detailed in Section 5.2.12.

Storm-water runoff from construction areas could potentially impact downstream surface water quality, although any effects on runoff quality would likely be localized around immediate points of disturbance or construction lay-down areas. However, appropriate soil erosion and sediment control measures (e.g., sediment fences, stacked haybales, mulching disturbed areas, etc.) and spill prevention practices would be employed during construction to minimize suspended sediment and material transport and potential water quality impacts. As discussed in Section 4.2.6.1, TA-18 is located in a flood-prone area located at the confluence of the arroyos associated with Pajarito and Three Mile Canyons. DOE has recently completed a project to secure the TA-18 Pajarito site complex from flooding, including the installation of structural controls. The new buildings proposed for construction as part of this upgrade would be similarly protected and sited in accordance with applicable regulatory requirements and DOE orders (e.g., DOE Order 420.1), including Executive Order 11988, *Floodplain Management*.

Operations Impacts—No impacts on surface water resources are expected as a result of facility operations at TA-18 under this alternative. No surface water would be used to support facility activities and there would be no direct discharge of sanitary or industrial effluent to surface waters. Sanitary wastewater would be generated as a result of facility operations stemming from facility staff use of lavatory, shower, and break-room facilities and from miscellaneous potable and sanitary uses. Nevertheless, it is planned that this wastewater would be collected and conveyed by a new site sanitary sewer system for ultimate disposal via appropriate wastewater treatment facilities. In addition, no industrial or other National Pollutant Discharge Elimination System (NPDES)-regulated discharges to surface waters are anticipated, as there are no such discharges from current TA-18 facilities. Waste generation and management activities are detailed in Section 5.2.12. Also, the design and operations of new and modified facilities would incorporate appropriate storm-water management controls to safely collect and convey storm water from facilities while minimizing washout and soil erosion. Overall, operational impacts on site surface waters and downstream water quality would be expected to be negligible.

LANL New Facility Alternative

Construction Impacts—There are no natural surface water drainages in the vicinity of the TA-55 Plutonium Facility Complex and no surface water would be used to support facility construction. As previously discussed for the TA-18 Upgrade Alternative, it is expected that portable toilets would be used for construction personnel, resulting in no onsite discharge of sanitary wastewater and no impact on surface waters. Waste generation and management activities are detailed in Section 5.2.12.

Storm-water runoff from construction areas could potentially impact downstream surface water quality. Although construction activities could disturb up to 1.8 hectares (4.5 acres) of land northwest of Plutonium Facility 4 in TA-55, appropriate soil erosion and sediment control measures (e.g., sediment fences, stacked haybales, mulching disturbed areas, etc.) and spill prevention practices would be employed during construction to minimize suspended sediment and material transport and potential water quality impacts. The TA-55 Plutonium Facility Complex is not in an area prone to flooding, and no floodplains are known to have been delineated in the immediate vicinity. Relocation of TA-18 operational capabilities and materials to this site would remove them from their current flood-prone area at TA-18.

Operations Impacts—No appreciable impacts on surface water resources are expected as a result of facility operations at TA-55 under this alternative for the same reasons as discussed for the TA-18 Upgrade Alternative.

5.2.6.2 Groundwater

No Action Alternative

No additional impacts on groundwater availability or quality are anticipated at LANL under the No Action Alternative beyond the effects of existing and projected activities described in the Expanded Operations Alternative of the *LANL SWEIS* (DOE 1999b), which are independent of this proposed action.

TA-18 Upgrade Alternative

Construction Impacts—Water would be required during construction for such uses as dust control and soil compaction, washing and flushing activities, and to meet the potable and sanitary needs of construction employees. Water use by construction personnel would be greatly reduced over that normally required by the proposed use of portable toilets. In addition, concrete and the water required for concrete mixing would likely be procured off site. As a result, it is estimated that construction activities would require approximately 2.9 million liters (766,000 gallons) of groundwater on an annual basis (see Table 5–3) to support facility upgrades and modifications. It is currently anticipated that this water would be derived from LANL groundwater supply sources via a temporary service connection or trucked to the point of use, especially during the early stages of construction. The relatively small volume of groundwater required during the period of construction compared to site availability and historic usage indicates that construction withdrawals should not have an additional impact on regional groundwater levels or availability. Although construction dewatering is not expected to be required, perched groundwater bodies could potentially be encountered during site excavation of the canyon-bottom alluvium at TA-18. Excavation activities would not be expected to affect groundwater quality or flow.

There would be no onsite discharge of wastewater to the surface or subsurface, and appropriate spill prevention controls, countermeasures, and procedures would be employed to minimize the chance for petroleum, oils, lubricants, and other materials used during construction to be released to the surface or subsurface and to ensure that waste materials are properly disposed of. Waste generation and management activities are detailed in Section 5.2.12. In general, no impact on groundwater availability or quality is anticipated.

Operations Impacts—As is the case under the No Action Alternative, groundwater would continue to be used at TA-18 primarily to meet the potable and sanitary needs of facility personnel housed in upgraded facilities, as well as for miscellaneous building mechanical uses. It is estimated that TA-18 operations under this alternative would require about 14.6 million liters (3.86 million gallons) per year of groundwater (see Table 5–4). As this demand would be bounded by that required for existing TA-18 operations, which is a small fraction of total LANL usage, and would not exceed site availability, no additional impact on regional groundwater availability would be anticipated.

No sanitary or industrial effluent would be discharged to the surface or subsurface. Waste generation and management activities are detailed in Section 5.2.12. Thus, no operational impacts on groundwater quality would be expected.

LANL New Facility Alternative

Construction Impacts—Groundwater would be required to support construction activities as discussed for this alternative. It is estimated that construction activities under the LANL New Facility Alternative would require approximately 17 million liters (4.5 million gallons) of groundwater on an annual basis (see Table 5–3). Similar to the TA-18 Upgrade Alternative, the volume of groundwater required for construction would be small compared to site availability and historic usage, and there would be no onsite discharge of wastewater to the surface or subsurface. Also, appropriate spill prevention controls, countermeasures, and procedures would be employed to minimize the potential for releases of materials to the surface or subsurface. As a result, no impact on groundwater availability or quality is anticipated from construction activities in TA-55.

Operations Impacts—Buildings housing the relocated operations and activities at TA-55 under the LANL New Facility Alternative would use groundwater primarily to meet the potable and sanitary needs of facility support personnel, as well as for miscellaneous building mechanical uses. It is estimated that new building operations under this alternative would require about 6.9 million liters (1.8 million gallons) per year of groundwater. This demand is a small fraction of total LANL usage and would not exceed site availability (see Table 5–4). Therefore, no additional impact on regional groundwater availability would be anticipated.

No sanitary or industrial effluent would be discharged to the surface or subsurface. Waste generation and management activities are detailed in Section 5.2.12. Thus, no operational impacts on groundwater quality would be expected.

5.2.7 Ecological Resources

5.2.7.1 Terrestrial Resources

No Action Alternative

Under the No Action Alternative, impacts on terrestrial resources would not occur at TA-18 (or LANL), since no new facilities would be built and current facilities do not produce emissions or effluent of a quality or at levels that would likely affect wildlife.

TA-18 Upgrade Alternative

Construction Impacts—With the exception of a dome warehouse, all new facilities associated with this alternative would be built within the current TA-18 security fence and would not impact terrestrial resources at LANL. The new dome warehouse would be built to the west of Building 30 and would require relocation of the security fence. Construction would disturb about 0.2 hectares (0.5 acres) of previously cleared land; thus, no pinyon-juniper woodland would be disturbed by construction. This area is currently maintained as grassland.

Wildlife use of the new dome warehouse site is limited due to its small size, proximity to the security fence, and its grassland status. Noise associated with earthmoving activities and construction could cause temporary disturbance to wildlife found in areas adjacent to the construction site; however, such disturbance would be temporary. Since all activities would take place within a defined construction zone, direct human disturbance to wildlife and wildlife habitat outside of that zone, such as might be caused by the movement of equipment, would not occur.

Operations Impacts—Operations of facilities associated with TA-18 would not adversely impact either wildlife or wildlife habitat at the site under this alternative. Operations at upgraded TA-18 buildings and new buildings would not produce emissions or effluent of a quality or at levels that would likely affect wildlife.

LANL New Facility Alternative

Construction Impacts—Under this alternative, the construction of a new below-grade critical assembly facility building and three new aboveground buildings (i.e., Central Utility Building, Low-Scatter Building, and Protected-Area Access-Control Building) would disturb 1.8 hectares (4.5 acres) of land at TA-55. These new buildings would be located to the northwest of Plutonium Facility 4. The construction site is within the ponderosa pine forest vegetative zone of LANL. Since this area was burned at a low severity during the Cerro Grande Fire, some regeneration would be expected to occur by the time construction begins. Construction of new facilities would remove this regenerated vegetation and would preclude complete recovery of the ponderosa pine forest. However, the loss of 1.8 hectares (4.5 acres) of ponderosa pine forest represents a small percentage of this habitat type present within the immediate area or on LANL as a whole.

Wildlife using the site proposed for new buildings constructed under this alternative would be lost or displaced by construction. Once the new underground facility is complete, it would be covered with earth and revegetated with grasses. This could supply limited habitat; however, the species using the area would not be the same as those displaced by removal of the original ponderosa pine forest. Noise associated with earthmoving activities and construction could cause temporary disturbance to wildlife found in areas adjacent to the construction site; however, such disturbance would be temporary. Since all activities would take place within a defined construction zone, direct human disturbance to wildlife and wildlife habitat outside of that zone, such as might be caused by the movement of equipment, would not occur.

Operations Impacts—Operations of facilities associated with relocated TA-18 operational capabilities and materials would not be expected to impact either wildlife or wildlife habitat in the TA-55 area or LANL. Relocated TA-18 operations would not produce emissions or effluent of a quality or at levels that would likely affect wildlife.

5.2.7.2 Wetlands

No Action Alternative

Under the No Action Alternative, impacts on wetlands would not occur at TA-18 (or LANL), since no new construction would occur and would not be expected to undergo much change over the next 25 years.

TA-18 Upgrade Alternative

Construction and Operations Impacts—Construction and operations of new buildings under this alternative would not directly impact the one wetland located at the eastern end of TA-18. Further, erosion and sediment control measures would be undertaken during construction to ensure that indirect impacts would be avoided. Storm-water runoff and effluent discharge during operations would be expected to result in no adverse wetland impacts.

LANL New Facility Alternative

Construction and Operations Impacts—There are three wetlands located within TA-55 (see Section 4.2.7.2). None of these would be directly impacted by construction of the new buildings required to support relocated TA-18 operational capabilities and materials, and the implementation of proper erosion and sediment control measures during construction would prevent secondary impacts. During operations, storm-water runoff from the relocated TA-18 operations site would co-mingle with the storm-water runoff from the rest of TA-55. No direct or indirect adverse impacts on area wetlands is expected. Operational effluent discharge would not be produced of a quality or at levels that would adversely affect site area wetlands.

5.2.7.3 Aquatic Resources

No Action Alternative

Because no new buildings would be constructed under the No Action Alternative, and no aquatic resources are located at TA-18, no impacts on aquatic resources would occur at TA-18 (or LANL) from implementation of this alternative.

TA-18 Upgrade Alternative

Construction and Operations Impacts—There are no aquatic resources located at TA-18; thus, direct impacts on this resource would not occur under this alternative. Indirect impacts on aquatic resources located down-gradient from TA-18 would be prevented by implementation of appropriate erosion and sediment control measures during construction of new buildings. During operations, effluent discharge and storm-water runoff from TA-18 are not expected to result in either direct or indirect adverse impacts on area aquatic resources, as the quality and quantity of these should not undergo any changes.

LANL New Facility Alternative

Construction and Operations Impacts—There are no aquatic resources located at TA-55; thus, direct impacts on this resource would not occur from the implementation of this alternative. Indirect impacts on aquatic resources located down-gradient from TA-55 would be prevented by implementation of appropriate erosion and sediment control measures during construction activities. During operations, effluent discharge and storm-water runoff from the relocated TA-18 capabilities and materials at TA-55 would not be expected to result in any direct or indirect adverse impacts on area aquatic resources. The quantity of runoff and discharge would be a minor contribution to the watershed drainage downstream of TA-55.

5.2.7.4 Threatened and Endangered Species

No Action Alternative

Under the No Action Alternative, there would not be any impact on threatened and endangered species at LANL. Current TA-18 mission facilities do not produce any emissions or effluent that would likely affect any sensitive species that may occur at the site.

Upgrade Alternative

Construction Impacts—Impacts on threatened and endangered species resulting from implementation of the TA-18 Upgrade Alternative would be similar to that of the No Action Alternative, considering the activities at the facility would not change. Construction impacts would be minimal because the new construction would be on previously disturbed land, and vegetation cover at the construction sites is minimal.

Operations Impacts—Operations under this alternative would not impact threatened and endangered species because upgraded TA-18 mission facilities would not produce emissions or effluent of a quality or at levels that would likely affect these species.

LANL New Facility Alternative

Construction Impacts—Under the LANL New Facility Alternative, there would not be any adverse impacts expected on threatened and endangered species or their critical habitat due to construction. Sensitive species at TA-55 are found around the wetland areas, which would not be disturbed. In addition, the disturbance of approximately 1.8 hectares (4.5 acres) for construction of new buildings would be on previously disturbed sites. Under the *Los Alamos Threatened and Endangered Species Habitat Management Plan* (LANL 1998), surveys for threatened and endangered species would be completed prior to construction activities in areas where species may occur if land is disturbed; however, in the TA-55 developed area, this is not an issue.

Operations Impacts—Operations would not impact threatened and endangered species because relocated TA-18 operations would not produce emissions or effluent of a quality or at levels that would likely affect these species.

5.2.8 Cultural and Paleontological Resources

5.2.8.1 Prehistoric Resources

No Action Alternative

Under the No Action Alternative, there would be no facility modifications at TA-18, and operations would continue at the level described in the Expanded Operations Alternative of the *LANL SWEIS* (DOE 1999b). Since no new facilities would be built and operations would not change, there would be no impact on prehistoric resources at the site.

TA-18 Upgrade Alternative

Construction and Operations Impacts—Under this alternative, a new dome warehouse would be constructed outside of the current TA-18 security fence. All other new facilities associated with this alternative would be built within the current security fence. The new dome warehouse would be built to the west of Building 30 and would require relocation of the security fence. Construction would disturb about 0.2 hectares (0.5 acres) of land. In addition to new construction, several existing structures would be modified. Due to the disturbed nature of TA-18, impacts on prehistoric resources are unlikely to result from construction activities taking place within the security fence. However, the possibility exists that construction of the new dome warehouse could disturb previously unknown prehistoric resources. Prior to construction, a cultural resource survey would be conducted of the area to be disturbed. If prehistoric resources were discovered, during construction all work potentially affecting the resources would stop. This work stoppage would be followed by investigations by qualified cultural resource specialists; any coordination necessary with the State Historic Preservation Office; and development and implementation of measures to salvage these resources. Construction would not disturb the two known prehistoric sites located at TA-18 (see Section 4.2.8.1). Operations of TA-18 mission facilities would not affect prehistoric resources under this alternative.

LANL New Facility Alternative

Construction and Operations Impacts—Under this alternative, construction would disturb about 1.8 hectares (4.5 acres) of land to the northwest of Plutonium Facility 4. This area has not been surveyed for prehistoric resources and, therefore, prior to construction, a cultural resource survey would be conducted and site mitigations would be applied. As noted for the TA-18 Upgrade Alternative, if any such resources were located during construction, work would stop while appropriate action was taken. Construction would not disturb the one prehistoric lithic scatter known to be present at TA-55. Operation of relocated TA-18 capabilities at TA-55 would not affect prehistoric resources under this alternative.

5.2.8.2 Historic Resources

No Action Alternative

Under this alternative, there would be no facility modifications at TA-18, and operations would continue at the level described in the Expanded Operations Alternative of the *LANL SWEIS* (DOE 1999b). Since no new buildings would be constructed and operations would not change, there would be no impact on historic resources at the site.

TA-18 Upgrade Alternative

Construction and Operations Impacts—Neither new construction nor modifications to existing structures required to support the TA-18 Upgrade Alternative would be expected to adversely impact either the mule-train trail which runs through TA-18 or the Ashley Pond cabin. Also, building modifications would not be expected to affect the overall status of World War II and early cold-war-period structures at the site. However, these are historic structures that are potentially eligible for the National Register of Historic Places. Prior to the beginning of construction, a cultural resource survey, including historic building eligibility assessments, would be conducted both within the currently developed portion of the site and the area proposed for construction of the new dome warehouse. For those buildings determined to be eligible for the National Register, a Memorandum of Agreement would be prepared stating the measures required to resolve the adverse effects of building modification. These measures (which may include archival photography of buildings and equipment) would be completed prior to the start of modification activities at TA-18. Operations at TA-18 would not affect historic resources under this alternative.

LANL New Facility Alternative

Construction and Operations Impacts—This alternative would not impact the two historic sites located at TA-55 (see Section 4.2.8.2). Prior to the beginning of construction, a cultural resource survey would be conducted and site mitigation would be applied. Operations of relocated TA-18 capabilities and materials at TA-55 would not likely adversely affect historic resources under this alternative.

While there are no historic resource concerns with respect to TA-55, many of the buildings in TA-18 are historically significant and are potentially eligible for the National Register of Historic Places. Removing equipment and vacating buildings is considered an adverse effect to historic properties. Historic building eligibility assessments would be completed for all buildings in TA-18 and transmitted to the State Historic Preservation Office for concurrence. For those buildings determined to be eligible for the National Register, a Memorandum of Agreement would be prepared stating the measures required to resolve the adverse effects of removing equipment and vacating buildings. These measures (which may include archival photography of buildings and equipment, oral interviews with current or past site personnel, compiling building drawings, and preparing a detailed history) would be completed prior to the start of relocation activities at TA-18.

5.2.8.3 Native American Resources

No Action Alternative

Under this alternative, there would be no facility modifications at TA-18 and missions would continue at the level described in the Expanded Operations Alternative of the *LANL SWEIS* (DOE 1999b). Since no new facilities would be built and operations would not change, there would be no impact on Native American resources at the site.

TA-18 Upgrade Alternative

Construction and Operations Impacts—Modifications to existing structures required to support the TA-18 Upgrade Alternative would not adversely impact Native American resources. Although no such resources have been identified within the area proposed for the new dome warehouse, it is possible that the construction of this warehouse and a relocated security fence would impact Native American resources. Care would be taken during design to ensure that this would not happen. A cultural resources survey would be conducted prior to the beginning of construction of either the dome warehouse or the security fence. As noted in Section 5.2.8.1, if any Native American resources were located during construction, work would stop while appropriate action was taken. Operations at TA-18 would not affect Native American resources under this alternative.

LANL New Facility Alternative

Construction and Operations Impacts—The area at TA-55 proposed to house security Category I/II activities has not been surveyed for Native American resources, and, therefore, prior to construction, a cultural resource survey would be conducted and site mitigations, if needed, would be applied. Similar to the process identified in Section 5.2.8.1 for prehistoric resources, if any Native American resources were located during construction, work would stop while appropriate action was taken. Operations of relocated TA-18 capabilities and materials at TA-55 would not affect Native American resources under this alternative.

5.2.8.4 Paleontological Resources

No Action Alternative

Since no new construction would occur and operations would not change, and, as stated in Section 4.2.8.4, no paleontological sites have been reported to occur within LANL boundaries, there would be no impact on paleontological resources at the site.

TA-18 Upgrade Alternative

Construction and Operations Impacts—No paleontological sites have been reported to occur within LANL boundaries; therefore, construction and operations of a new dome warehouse at TA-18 in connection with this alternative would not impact paleontological resources.

LANL New Facility Alternative

Construction and Operations Impacts—Construction and operations of new buildings under this alternative would not impact paleontological resources, since no such resources have been identified at LANL.

5.2.9 Socioeconomics

No Action Alternative

Under the No Action Alternative, the current employment of approximately 212 workers at TA-18 would continue. No new employment or in-migration of workers would be required. Therefore, there would be no additional impact on the socioeconomic conditions around LANL.

TA-18 Upgrade Alternative

Construction Impacts—Modifications and upgrades to the existing TA-18 facilities would require a peak construction employment level of 110 workers. This level of employment would generate about 312 indirect jobs in the region around LANL. The potential total employment increase of 422 direct and indirect jobs represents an approximate 0.5 percent increase in the workforce and would occur only over the 24 months of construction. It would have no noticeable impact on the socioeconomic conditions of the region of influence.

Operations Impacts—Current employment of approximately 212 workers at TA-18 would continue. No new employment would be required. Therefore, there would be no additional impact on the socioeconomic conditions around LANL.

LANL New Facility Alternative

Construction Impacts—Construction of new buildings at TA-55 to house security Category I/II activities would require a peak construction employment level of 300 workers. This level of employment would generate about 852 indirect jobs in the region around LANL. The potential total employment increase of 1,152 direct and indirect jobs represents an approximate 1.3 percent increase in the workforce and would occur over the 16 months of construction. It would have no noticeable impact on the socioeconomic conditions of the region of influence.

Operations Impacts—Current employment levels in support of relocated TA-18 capabilities and materials would continue. No new employment or in-migration of workers would be required. Therefore, there would be no additional impact on the socioeconomic conditions around LANL.

5.2.10 Public and Occupational Health and Safety

The assessments of potential radiological impacts associated with LANL alternatives are presented in this section. No chemical-related health impacts are associated with any of these alternatives because only very small quantities of industrial-type chemicals, such as ethanol, isopropyl alcohol, magnesium oxide, phenylphosphine, and xylene, would be used. As stated in the *LANL SWEIS* (DOE 1999b), the quantities of these chemicals that could be released to the atmosphere during normal operations are minor and would be below the screening levels used to determine the need for additional analysis. There would be no operational increase in the use of these chemicals as a result of the proposed action. No chemicals have been identified that would be a risk to members of the public from construction activities associated with any of the LANL alternatives. Construction workers would be protected from hazardous chemicals by adherence to Occupational Safety and Health Administration (OSHA) and U.S. Environmental Protection Agency (EPA) occupational standards that limit concentrations of potentially hazardous chemicals. The potential occupational (industrial) impacts on workers during construction and operations were evaluated based on DOE and Bureau of Labor Statistic data; and are detailed in Section C.7 of Appendix C. Construction and operations activities under these alternatives would be expected to result in some injuries, but no fatalities, to workers for the duration of the proposed action (i.e., about 3 years of construction and 25 years of operations).

Summaries of radiological impacts from normal operations and postulated accidents are presented below. The methodologies used to determine the impacts on the public and facility workers are presented in Appendix B. Supplemental information associated with normal operations and postulated accidents is provided in Appendices B and C, respectively.

5.2.10.1 Construction and Normal Operations

No Action Alternative

Construction Impacts—There would be no radiological or hazardous chemical impacts on members of the public or workers because this alternative would not involve any construction.

Operations Impacts—Under this alternative, the only radiological release would be 110 curies per year of argon-41 to the atmosphere (see Section 5.2.3.2). The associated calculated impacts on the public are presented in **Table 5–8** for two types of receptors: the general public living within 80 kilometers (50 miles) of TA-18 and a maximally exposed offsite individual (a member of the public assumed to be residing at the LANL site boundary who receives the maximum dose). The only dose pathway for these receptors is from immersion in the passing plume. To put the doses into perspective, comparisons with natural background radiation levels are included in the table.

Table 5–8 Annual Radiological Impacts on the Public from Operations at TA-18 Facilities under the No Action Alternative

Receptor	*Impact Values*		
	Security Category I/II Activities	*Security Category III/IV and SHEBA Activities* [a]	*Total TA-18 Facilities*
Population within 80 Kilometers (50 Miles)			
Collective dose (person-rem)	0.0087	0.087	0.096
Percent of natural background radiation [b]	7.5×10^{-6}	7.5×10^{-5}	8.3×10^{-5}
Cancer fatalities [c]	4.4×10^{-6}	4.4×10^{-5}	4.8×10^{-5}
Maximally Exposed Offsite Individual			
Dose (millirem)	0.0061	0.061	0.067
Percent of regulatory dose limit [d]	0.061	0.61	0.67
Percent of natural background radiation [b]	0.0017	0.017	0.019
Cancer fatality risk [c]	3.1×10^{-9}	3.1×10^{-8}	3.4×10^{-8}
Average Individual within 80 Kilometers (50 Miles)			
Dose (millirem)	2.7×10^{-5}	2.7×10^{-4}	0.00030
Percent of natural background radiation [b]	7.5×10^{-6}	7.5×10^{-5}	8.3×10^{-5}
Cancer fatality risk [c]	1.4×10^{-11}	1.4×10^{-10}	1.5×10^{-10}

[a] Impacts on the public are principally from releases associated with SHEBA activities.
[b] The average annual dose from background radiation at LANL is 360 millirem (see Section 4.2.11.1); the 320,200 people living within 80 kilometers (50 miles) would receive an annual dose of 115,300 person-rem from the background radiation.
[c] Based on a cancer risk estimate of 0.0005 latent cancer fatalities per person-rem (see Appendix B).
[d] This comparison cannot be made for the population and average individual because there is no standard or limit.

As shown in the table, the expected annual radiation dose to the maximally exposed offsite individual member of the public would be much smaller than the limit of 10 millirem per year set by both the EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The risk of a latent cancer fatality to this individual from operations would be approximately 3.4×10^{-8} per year (i.e., about 1 chance in 29 million per year of a latent cancer fatality). The projected number of fatal cancers to the population within 80 kilometers (50 miles) would be 4.8×10^{-5} per year (i.e., about 1 chance in 20,000 per year of a latent cancer fatality).

Annual radiological doses to workers involved with TA-18 facility operations under this alternative are provided in **Table 5–9**.

As shown in the table, the annual doses to individual workers would be well below the DOE limit of 5,000 millirem (10 CFR 835) and the DOE recommended Administrative Control Level of 500 millirem (DOE 1999e). The projected number of fatal cancers in the workforce from annual operations would be 0.0085 (or 1 chance in 118 that the worker population would experience a fatal cancer per year of operations).

Table 5–9 Annual Radiological Impacts on LANL Workers from Operations at TA-18 Facilities under All LANL Alternatives

Receptor	Impact Values		
	Security Category I/II Activities	*Security Category III/IV and SHEBA Activities*	*Total TA-18 Facilities*
Individual Worker [a]			
Average worker dose (millirem)	100		
Average worker cancer fatality risk [b]	4.0×10^{-5}		
Worker Population [c]			
Collective dose (person-rem) [d]	10 [e]	11	21 [f]
Cancer fatality risk [b]	0.0040 [e]	0.0045	0.0085 [f]

[a] The average worker dose of 100 millirem and the average worker cancer fatality risk of 4.0×10^{-5} are applicable to all TA-18 activities. The regulatory dose limit for an individual worker is 5,000 millirem per year (10 CFR 835). However, the maximum annual dose to a worker would be kept below the DOE Control Level of 1,000 millirem per year, as established in 10 CFR 835.1002. Further, DOE recommends that facilities adopt a more limiting 500-millirem-per-year Administrative Control Level (DOE 1999e). To reduce doses to levels that are as low as is reasonably achievable, an effective dose reduction plan would be enforced.
[b] Based on a cancer risk estimator of 0.0004 latent cancer fatalities per person-rem (see Appendix B).
[c] The Expanded Operations Alternative in the *LANL SWEIS* estimates that 212 workers (technical and security personnel) would be involved in the TA-18 facilities operations.
[d] The collective dose is based on an assumed workforce split of 100 persons for security Category I/II activities and 110 persons for security Category III/IV and SHEBA activities.
[e] Applicable to the LANL New Facility Alternative.
[f] Applicable to the No Action and TA-18 Upgrade Alternatives.

TA-18 Upgrade Alternative

Construction Impacts—No radiological risks would be incurred by members of the public from construction activities. Construction workers would be at a small risk. They could receive doses above natural background radiation levels from exposure to radiation from other past or present activities at the site, including that associated with residual contamination at the facilities being upgraded. However, these workers would be protected through appropriate training, monitoring, and management controls. Their exposures would be limited to ensure that doses were kept as low as is reasonably achievable.

Operations Impacts—Under this alternative, the only radiological release would be 110 curies per year of argon-41 to the atmosphere (see Section 5.2.3.2). The calculated associated impacts on the public would be identical to the impacts shown for the No Action Alternative as described earlier in this section.

Similarly, annual radiological doses to workers involved with TA-18 facility operations under this alternative would be similar to the impacts described for the No Action Alternative. The annual doses to individual workers would be well below the DOE limit of 5,000 millirem (10 CFR 835); the DOE Control Level of 1,000 millirem per year as established in 10 CFR 835.1002; and the DOE recommended Administrative Control Level of 500 millirem (DOE 1999e). The projected number of fatal cancers in the workforce from annual operations would be 0.0040 (or 1 chance in 250 that the workers would experience a fatal cancer per year of operations).

LANL New Facility Alternative

Construction Impacts—No radiological risks would be incurred by members of the public from construction activities. Construction workers would be at a small risk. They could receive doses above natural background radiation levels from exposure to radiation from other past or present activities at the site.

However, these workers would be protected through appropriate training, monitoring, and management controls. Their exposures would be limited to ensure that doses were kept as low as is reasonably achievable.

Operations Impacts—Under this alternative, the only radiological release associated with operations of the TA-18 capabilities and materials at TA-55 would be 10 curies per year of argon-41 to the atmosphere from Godiva operations (see Section 5.2.3.2). The calculated impacts on the public are presented in **Table 5–10**. The only dose pathway for receptors is from immersion in the passing plume. To put the doses into perspective, comparisons with natural background radiation are included in the table.

Table 5–10 Annual Radiological Impacts on the Public from Relocated TA-18 Operations under the LANL New Facility Alternative

Receptor	***Impact Values***
Population within 80 Kilometers (50 Miles)	
Collective dose (person-rem)	0.011
Percent of natural background radiation [a]	1.1×10^{-5}
Cancer fatalities [b]	5.5×10^{-6}
Maximally Exposed Offsite Individual	
Dose (millirem)	0.0025
Percent of regulatory dose limit [c]	0.025
Percent of natural background radiation [a]	0.00069
Cancer fatality risk [b]	1.3×10^{-9}
Average Individual within 80 Kilometers (50 Miles)	
Dose (millirem)	3.9×10^{-5}
Percent of natural background radiation [a]	1.1×10^{-5}
Cancer fatality risk [b]	2.0×10^{-11}

[a] The average annual dose from background radiation at LANL is 360 millirem (see Section 4.2.11.1); the 283,600 people living within 80 kilometers (50 miles) of the TA-55 site would receive an annual dose of 115,300 person-rem from the background radiation.
[b] Based on a cancer risk estimate of 0.0005 latent cancer fatalities per person-rem (see Appendix B).
[c] This comparison cannot be made for the population and average individual because there is no standard or limit.

As shown in the table, the expected annual dose to the maximally exposed offsite individual member of the public would be much smaller than the limit of 10 millirem per year set by both the EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The risk of a cancer fatality to this individual from operations would be approximately 1.3×10^{-9} per year (i.e., about 1 chance in 700 million per year of a latent cancer fatality). The projected number of fatal cancers to the population within 80 kilometers (50 miles) would be 5.5×10^{-6} per year (i.e., about 1 chance in 180,000 per year of a latent cancer fatality).

Annual radiological doses to workers involved with TA-55 facility operations under this alternative would be similar to the impacts shown for the TA-18 security Category I/II activities under the No Action Alternative, as described earlier in this section. As stated, the annual doses to individual workers would be well below the DOE limit of 5,000 millirem (10 CFR 835); the DOE Control Level of 1,000 millirem per year as established in 10 CFR 835.1002; and the DOE recommended Administrative Control Level of 500 millirem (DOE 1999e). The projected number of fatal cancers in the workforce from annual operations would be 0.0040 (or 1 chance in 250 that the workers would experience a fatal cancer per year of operations).

5.2.10.2 Facility Accidents

This section presents the potential impacts on workers (both involved and noninvolved) and the public due to accidents for the No Action, TA-18 Upgrade, and LANL New Facility Alternatives. Additional details supporting the information presented here are provided in Appendix C.

No Action Alternative

Under the No Action Alternative at LANL, TA-18 facilities and operations would remain unchanged. Potential hazards and accidents for TA-18 facilities and operations, applicable to the No Action Alternative, have been studied in detail and are described in a LANL report detailing the *Basis for Interim Operations for the Los Alamos Critical Experiments Facility and Hillside Vault (TA-18 BIO)* (DOE 2001a).

Radiological Impacts—**Table 5–11** shows the frequencies and consequences of the postulated set of accidents for a noninvolved worker and the public (maximally exposed offsite individual and the general population living within 80 kilometers [50 miles] of the facility). **Table 5–12** shows the accident risks, obtained by multiplying the consequences by the likelihood (frequency per year) that an accident would occur. The accidents listed in these tables were selected from a wide spectrum of accidents described in the *TA-18 BIO* (DOE 2001a). The selection process and screening criteria used (see Appendix C) ensure that the accidents chosen for evaluation in this EIS bound the impacts of all reasonably foreseeable accidents that could occur at TA-18 facilities. Thus, in the event that any other accident that was not evaluated in this EIS were to occur, its impacts on workers and the public would be expected to be within the range of the impacts evaluated.

The accident with the highest risk to the offsite population (see Table 5–12) is the hydrogen detonation accident in SHEBA. The increased number of latent cancer fatalities in the offsite population would be 5.1×10^{-5} per year (i.e., about 1 chance in 19,000 per year of a latent cancer fatality). The highest risk of a latent cancer fatality to the maximally exposed offsite individual would be a 1.7×10^{-7} per year (i.e., about one chance in 5 million per year of a latent cancer fatality). The highest risk of a latent cancer fatality to a noninvolved worker located at a distance of 400 meters (437 yards) from the accident would be 2.0×10^{-6} per year (i.e., about 1 chance in 500,000 per year of a latent cancer fatality).

Hazardous Chemicals and Explosives Impacts—There would be no hazardous chemicals or explosives used or stored at TA-18, other than minor industrial quantities, that would impact workers or the public under accident conditions.

<u>Involved Worker Impacts</u>

Approximately 100 workers would be at TA-18 during operations. Most of the workers would be located near the main operations area (Building 30). During criticality experiments, workers would be safely located beyond a prescribed distance from the experiments.

Workers in the vicinity of an accident could be at risk of serious injury or fatality. The impacts from the uncontrolled reactivity insertion on Comet or Planet assemblies with a plutonium core provides an indication of typical worker impacts during accident conditions.

Facility operating procedures prohibit personnel from being in the test facility during remote operation of the Comet or Planet assemblies. If an accident were to occur during a test run due to improper experiment setup and/or a combination of operator errors from the control room, the involved workers would be in the remote-control room and no workers would be present in the test facility. Workers in the remote-control room would be protected from direct radiation by a combination of shielding and distance from the immediate impacts of the accident. However, because of lack of building heating, ventilating, and air conditioning high-efficiency particulate air filtration at TA-18, the control-room operators would be exposed to the radiological plume that would be released after the accident. The protective actions taken by the control-room staff would limit contamination of the control-room environment and protect the involved workers.

In the event that workers setting up a test in the experiment bay inside the Critical Assembly Storage Area (CASA) initiate a criticality accident, it is anticipated that those workers would be subject to serious injury or fatality as a result of the accident.

Table 5–11 Accident Frequency and Consequences under the No Action Alternative

		Maximally Exposed Offsite Individual		*Offsite Population* [a]		*Noninvolved Worker*	
	Frequency (per year)	*Dose (rem)*	*Latent Cancer Fatalities* [b]	*Dose (person-rem)*	*Latent Cancer Fatalities* [c]	*Dose (rem)*	*Latent Cancer Fatalities* [b]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core accident							
	1.0×10^{-6}	8.70	0.0044	2,580	1.30	133	0.11
Bare, fully reflected or moderated metal criticality accident							
	1.0×10^{-4}	2.5×10^{-7}	1.3×10^{-10}	6.7×10^{-5}	3.3×10^{-8}	2.6×10^{-6}	1.0×10^{-9}
Uncontrolled reactivity insertion in SHEBA in burst mode accident							
	1.0×10^{-6}	22.2	0.022	6,580	3.9	340	0.27
High-pressure spray fire on a Comet machine with a plutonium core accident							
	1.0×10^{-6}	2.1	0.0011	2,180	1.1	6.28	0.0025
Hydrogen detonation in SHEBA accident							
	5.4×10^{-3}	0.063	3.1×10^{-5}	18.8	0.0094	0.91	0.00036
Earthquake-induced facility failures without fire accident							
	1.0×10^{-4}	0.41	0.00021	158	0.079	6.0	0.0024
Inadvertent solution criticality in SHEBA accident							
	1.0×10^{-6}	0.00019	9.3×10^{-8}	0.058	2.9×10^{-5}	0.0018	7.2×10^{-7}

[a] Based on a population of 320,182 persons residing within 80 kilometers (50 miles) of the site.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

Table 5–12 Annual Cancer Risks Due to Accidents under the No Action Alternative

Accident	*Maximally Exposed Offsite Individual* [a]	*Offsite Population* [b, c]	*Noninvolved Worker* [a]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	4.35×10^{-9}	1.3×10^{-6}	1.1×10^{-7}
Bare, fully reflected or moderated metal criticality	1.3×10^{-14}	3.3×10^{-12}	1.0×10^{-13}
Uncontrolled reactivity insertion in SHEBA in burst mode	2.2×10^{-8}	3.9×10^{-6}	2.7×10^{-7}
High-pressure spray fire on a Comet machine with a plutonium core	1.1×10^{-9}	1.1×10^{-6}	2.5×10^{-9}
Hydrogen detonation in SHEBA	1.7×10^{-7}	5.1×10^{-5}	2.0×10^{-6}
Earthquake-induced facility failures without fire	2.1×10^{-8}	7.9×10^{-6}	2.4×10^{-7}
Inadvertent solution criticality in SHEBA	9.3×10^{-14}	2.9×10^{-11}	7.2×10^{-13}

[a] Increased risk of a latent cancer fatality.
[b] Risk of increased number of latent cancer fatalities.
[c] Based on a population of 320,182 persons residing within 80 kilometers (50 miles) of the site.

Following initiation of accident/site emergency alarms, workers in adjacent areas of the facility would evacuate the area in accordance with technical area and test facility emergency operating procedures and training in place.

TA-18 Upgrade Alternative

Under the TA-18 Upgrade Alternative at LANL, TA-18 buildings and operations would be upgraded and include installation of high-efficiency particulate air filters. Potential hazards and accidents for TA-18 buildings and operations, applicable to the TA-18 Upgrade Alternative, have been studied in detail and are described in the *TA-18 BIO* (DOE 2001a).

Radiological Impacts—**Table 5–13** shows the frequencies and consequences of the postulated set of accidents for a noninvolved worker and the public (maximally exposed offsite individual and the general population living within 80 kilometers [50 miles] of the facility). **Table 5–14** shows the accident risks, obtained by multiplying the consequences by the likelihood (frequency per year) that an accident would occur. The accidents listed in these tables were selected from a wide spectrum of accidents described in the *TA-18 BIO* (DOE 2001a). The selection process and screening criteria used (see Appendix C) ensure that the accidents chosen for evaluation in this EIS bound the impacts of all reasonably foreseeable accidents that could occur at TA-18 facilities. Thus, in the event that any other accident not evaluated in this EIS were to occur, its impacts on workers and the public would be expected to be within the range of the impacts evaluated.

The accident with the highest risk to the offsite population (see Table 5–14) is the hydrogen detonation accident in SHEBA. The increased number of latent cancer fatalities in the offsite population would be 5.1×10^{-5} per year (i.e., about 1 chance in 19,000 per year of a latent cancer fatality). The highest risk of a latent cancer fatality to the maximally exposed offsite individual would be a 1.7×10^{-7} per year (i.e. About 1 chance in 5 million per year of a latent cancer fatality). The highest risk of a latent cancer fatality to a noninvolved worker located at a prescribed distance of 400 meters (437 yards) from the accident would be 2.0×10^{-6} per year (i.e., about 1 chance in 500,000 per year of a latent cancer fatality).

Hazardous Chemicals and Explosives Impacts—There would be no hazardous chemicals or explosives used or stored at TA-18, other than minor industrial quantities, that would impact workers or the public under accident conditions.

<u>Involved Worker Impacts</u>

Approximately 100 workers would be at TA-18 during operations. Most of the workers would be located near the main operations area (Building 30). During criticality experiments, workers would be safely located beyond a prescribed distance from the experiments.

Workers in the vicinity of an accident could be at risk of serious injury or fatality. The impacts from the uncontrolled reactivity insertion on the Comet or Planet assemblies with a plutonium core provides an indication of typical worker impacts during accident conditions.

Facility operating procedures prohibit personnel from being in the test facility during remote operation of the Comet or Planet assemblies. If an accident were to occur during a test run due to improper experiment setup and/or a combination of operator errors from the control room, the involved workers would be in the remote-control room and no workers would be present in the test facility. Workers in the remote-control room would be protected from direct radiation by a combination of shielding and distance from the immediate impacts of the accident. However, because of lack of building heating, ventilating, and air conditioning/high-efficiency particulate air filtration at TA-18, the control-room operators would be exposed to the radiological plume that would be released after the accident. The protective actions taken by the control-room staff would limit contamination of the control-room environment and protect the involved workers.

In the event that workers setting up a test in the experiment bay inside the CASA initiate a criticality accident, it is anticipated that workers in the nearby area would be subject to serious injury or fatality as a result of the accident.

Table 5–13 Accident Frequency and Consequences under the TA-18 Upgrade Alternative

		Maximally Exposed Offsite Individual		*Offsite Population* [a]		*Noninvolved Worker*	
	Frequency (per year)	*Dose (rem)*	*Latent Cancer Fatalities* [b]	*Dose (person-rem)*	*Latent Cancer Fatalities* [c]	*Dose (rem)*	*Latent Cancer Fatalities* [b]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core accident							
	1.0×10^{-6}	0.0087	4.4×10^{-6}	2.58	0.0013	0.13	5.3×10^{-5}
Bare, fully reflected or moderated metal criticality accident							
	1.0×10^{-4}	2.5×10^{-10}	1.3×10^{-13}	6.7×10^{-8}	3.3×10^{-11}	2.6×10^{-9}	1.0×10^{-12}
Uncontrolled reactivity insertion in SHEBA in burst mode accident							
	1.0×10^{-6}	22.2	0.022	6,580	3.9	339	0.27
High-pressure spray fire on a Comet machine with a plutonium core accident							
	1.0×10^{-6}	0.21	0.00011	218	0.11	0.63	0.00025
Hydrogen detonation in SHEBA accident							
	5.4×10^{-3}	0.063	3.1×10^{-5}	18.8	0.0094	0.91	0.00036
Earthquake-induced facility failures without fire accident							
	1.0×10^{-4}	0.41	0.00021	158	0.079	6.0	0.00024
Inadvertent solution criticality in SHEBA accident							
	1.0×10^{-6}	0.00019	9.3×10^{-8}	0.058	2.9×10^{-5}	0.0018	7.2×10^{-7}

[a] Based on a population of 320,182 persons residing within 80 kilometers (50 miles) of the site.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

Table 5–14 Annual Cancer Risks Due to Accidents under the TA-18 Upgrade Alternative

Accident	*Maximally Exposed Offsite Individual* [a]	*Offsite Population* [b, c]	*Noninvolved Worker* [a]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	4.4×10^{-12}	1.3×10^{-9}	5.3×10^{-11}
Bare, fully reflected or moderated metal criticality	1.3×10^{-17}	3.3×10^{-15}	1.0×10^{-16}
Uncontrolled reactivity insertion in SHEBA in burst mode	2.2×10^{-8}	3.9×10^{-6}	2.7×10^{-7}
High-pressure spray fire on a Comet machine with a plutonium core	1.1×10^{-10}	1.1×10^{-7}	2.5×10^{-10}
Hydrogen detonation in SHEBA	1.7×10^{-7}	5.1×10^{-5}	2.0×10^{-6}
Earthquake-induced facility failures without fire	2.1×10^{-8}	7.9×10^{-6}	2.4×10^{-7}
Inadvertent solution criticality in SHEBA	9.3×10^{-14}	2.9×10^{-11}	7.2×10^{-13}

[a] Increased risk of a latent cancer fatality.
[b] Risk of increased number of latent cancer fatalities.
[c] Based on a population of 320,182 persons residing within 80 kilometers (50 miles) of the site.

LANL New Facility Alternative

Under the LANL New Facility Alternative, the TA-18 capabilities and materials would be relocated to new buildings to be constructed at LANL TA-55. The new buildings would include safety features that would reduce the risks of accidents that currently exist under the No Action Alternative. From an accident perspective, the proposed new criticality experiments facility would be a robust structure that meets the performance category 3, seismic requirements, and has a full confinement system that includes a tiered pressure zone ventilation and high-efficiency particulate air filters. The accident scenarios described for the No Action Alternative are considered applicable to the LANL New Facility Alternative, with one exception. Accidents associated with SHEBA are excluded because the SHEBA missions would not be moved to LANL's TA-55. The impacts of its proposed relocation to LANL TA-39 are detailed in Section 5.6.3.10. Certain scenario parameter values applicable to the No Action Alternative, such as leak path factors, materials at risk, and the corresponding source term, were adjusted in the impacts analysis to reflect improved safety features of the new structures.

Radiological Impacts—**Table 5–15** shows the frequencies and consequences of the postulated set of accidents for noninvolved worker and the public (maximally exposed offsite individual and the general population living within 80 kilometers [50 miles] of the facility). **Table 5–16** shows the accident risks, obtained by multiplying the consequences by the likelihood (frequency per year) that an accident would occur. The accidents listed in these tables were selected from a wide spectrum of accidents described in the *TA-18 BIO* (DOE 2001a). The selection process and screening criteria used (see Appendix C) ensure that the accidents chosen for evaluation in this EIS bound the impacts of all reasonably foreseeable accidents that could occur at TA-18 facilities. Consideration has also been given to the possibility of an accident at a TA-55 collocated facility that could initiate an accident at the new LANL facility. Because of the underground location of the new LANL facility and distance to any nearby facilities, it was determined that there were no reasonably foreseeable collocated accidents that could affect the new LANL facility. Thus, in the event that any other accident not evaluated in this EIS were to occur, its impacts on workers and the public would be expected to be within the range of the impacts evaluated.

The accident with the highest risk to the offsite population (see Table 5–16) is a high-pressure spray fire on a Comet machine with a plutonium core accident. The increased number of latent cancer fatalities in the offsite population would be 9.1×10^{-8} per year (i.e., about 1 chance in 10 million per year of a latent cancer fatality). The highest risk of a latent cancer fatality to the maximally exposed offsite individual would be 6.1×10^{-11} per year (i.e., about 1 chance in 15 billion per year of a latent cancer fatality). The highest risk of a latent cancer fatality to a noninvolved worker located at a distance of 100 meters (109 yards) from the accident would be 1.6×10^{-9} per year (i.e., about 1 chance in 600 million per year of a latent cancer fatality).

Hazardous Chemicals and Explosives Impacts—There would be no hazardous chemicals or explosives used or stored at the new TA-55 facilities, other than minor industrial quantities, that would impact workers or the public under accident conditions.

Involved Worker Impacts

Approximately 100 workers would be located at the LANL new TA-55 facility. During criticality experiments, workers would be safely located beyond a prescribed distance from the experiments.

Workers in the vicinity of an accident could be at risk of serious injury or fatality. The impacts from the uncontrolled reactivity insertion on the Comet or Planet assemblies with a plutonium core provides an indication of typical worker impacts during accident conditions.

Facility operating procedures prohibit personnel from being in the test facility during remote operation of the Comet or Planet assemblies. If an accident were to occur during a test run due to improper experiment setup and/or a combination of operator errors from the control room, the involved workers would be in the remote-control room and no workers would be present in the test facility. Workers in the remote-control room would be protected by a combination of heating, ventilating, and air conditioning/high-efficiency particulate air filtration; shielding; and distance from the immediate impacts of the accident. The remote-control room engineered safety features and/or protective actions taken by the control-room staff to limit contamination of the control-room environment would also protect the involved workers.

In the event that workers setting up a test in the bay area initiate an accident, it is anticipated these workers would be subject to serious injury or fatality as a result of the accident. Since the facility operating procedures would not prohibit workers from being in adjacent areas during operations, it is anticipated that workers in the vicinity outside of the bay would receive an estimated dose of less than 200 millirem after an uncontrolled criticality event. (This is estimated based on the potential energy released during this accident in relation to that used to design the shielding requirements.)

The facility ventilation system would control dispersal of the airborne radiological debris from the accident. Following initiation of accident/site emergency alarms, workers would evacuate the area in accordance with site emergency operating procedures and would not be vulnerable to additional radiological risk of injury.

Table 5–15 Accident Frequency and Consequences under the LANL New Facility Alternative

		Maximally Exposed Offsite Individual		*Offsite Population* [a]		*Noninvolved Worker*	
	Frequency (per year)	*Dose (rem)*	*Latent Cancer Fatalities* [b]	*Dose (person-rem)*	*Latent Cancer Fatalities* [c]	*Dose (rem)*	*Latent Cancer Fatalities* [b]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core accident							
	1.0×10^{-6}	0.0034	1.7×10^{-6}	2.89	0.0014	1.53	0.00061
Bare, fully reflected or moderated metal criticality accident							
	1.0×10^{-4}	1.2×10^{-10}	6.0×10^{-14}	8.5×10^{-8}	4.2×10^{-11}	2.6×10^{-8}	1.0×10^{-11}
High-pressure spray fire on Comet machine with a plutonium core							
	1.0×10^{-6}	0.12	6.1×10^{-5}	181	0.091	4.06	0.0016
Earthquake-induced facility failures without fire							
	1.0×10^{-4}	0.00016	7.8×10^{-8}	0.16	8.0×10^{-5}	0.064	2.6×10^{-5}

[a] Based on a population of 283,571 persons residing within 80 kilometers (50 miles) of the site.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

Table 5–16 Annual Cancer Risks Due to Accidents under the LANL New Facility Alternative

Accident	*Maximally Exposed Offsite Individual* [a]	*Offsite Population* [b,c]	*Noninvolved Worker* [a]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	1.7×10^{-12}	1.4×10^{-9}	6.1×10^{-10}
Bare, fully reflected or moderated metal criticality	6.0×10^{-18}	4.2×10^{-15}	1.03×10^{-15}
High-pressure spray fire on a Comet machine with a plutonium core	6.1×10^{-11}	9.1×10^{-8}	1.6×10^{-9}
Earthquake-induced facility failures without fire	7.8×10^{-12}	8.0×10^{-9}	2.6×10^{-9}

[a] Increased risk of a latent cancer fatality.
[b] Risk of increased number of latent cancer fatalities.
[c] Based on a population of 283,571 persons residing within 80 kilometers (50 miles) of the site.

5.2.11 Environmental Justice

No Action Alternative

No disproportionately high and adverse environmental impacts on minority and low-income populations would occur under the No Action Alternative. This conclusion is a result of investigations in this EIS that determined there were no significant impacts on human health, ecological, cultural, paleontological, socioeconomic, and other resource areas described in other subsections of Section 5.2

During normal operations at TA-18, up to 110 curies of the noble gas argon-41 could be activated in the atmosphere. The impacts measured in terms of latent cancer fatalities on the general population would be small, as indicated in Table 5–8. Subsistence consumption of crops and wildlife radiologically contaminated with argon-41 would not be harmful since argon-41 has a half-life of 1 hour and 48 minutes and decays into a stable isotope of potassium that is not harmful to human health in small quantities.

Columns 2 and 3 of Table 5–12 show the radiological risks to the maximally exposed offsite individual and offsite population, respectively, that could result from postulated accidents under the No Action Alternative. All of these risks are at least four orders of magnitude less than one latent cancer fatality. Hence, none of the postulated accidents would pose a significant radiological risk to the public, including minority and low-income individuals and groups within the population at risk.

TA-18 Upgrade Alternative

Construction Impacts—There would be no disproportionately high and adverse environmental impacts on minority and low-income populations due to construction under the TA-18 Upgrade Alternative. As stated in other subsections of Section 5.2, environmental impacts from construction would be small and would not be expected to extend beyond the LANL site boundary.

Operational Impacts—Environmental impacts on minority and low-income populations due to operations and accidents under the TA-18 Upgrade Alternative would be the same as described for the No Action Alternative.

LANL New Facility Alternative

Construction Impacts—There would be no disproportionately high and adverse environmental impacts on minority and low-income populations due to construction under the LANL New Facility Alternative. As stated in other subsections of Section 5.2, environmental impacts from construction would be small and would not be expected to extend beyond the LANL site boundary.

Operations Impacts—No disproportionately high and adverse environmental impacts on minority and low-income populations would occur under the LANL New Facility Alternative. This conclusion is a result of analyses presented in this EIS that determined there were no significant impacts on human health, ecological, cultural, paleontological, socioeconomic, and other resource areas described in other subsections of Section 5.2

During normal operations, approximately 10 curies of the noble gas argon-41 could be activated in the atmosphere. The impacts measured in terms of latent cancer fatalities on the general population would be small, as indicated in Table 5–10. Additionally, subsistence consumption of crops and wildlife radiologically contaminated with argon-41 would not be harmful since argon-41 has a half-life of 1 hour and 48 minutes and decays into a stable isotope of potassium that is not harmful to human health in small quantities.

Columns 2 and 3 of Table 5–16 show the radiological risks to the maximally exposed offsite individual and offsite population, respectively, that could result from postulated accidents under the LANL New Facility Alternative. All of these risks are at least seven orders of magnitude less than one latent cancer fatality. Hence, none of the postulated accidents would pose a significant radiological risk to the public, including minority and low-income individuals and groups within the population at risk.

5.2.12 Waste Management

In accordance with the Records of Decision for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (*Waste Management PEIS*) (DOE 1997a), waste could be treated and disposed of on site at LANL or at other DOE sites or commercial facilities. Based on the Record of Decision for hazardous waste published on August 5, 1998 (63 FR 41810), nonwastewater hazardous waste will continue to be treated and disposed of at offsite commercial facilities. Based on the Record of Decision for low-level radioactive waste and mixed low-level radioactive waste published on February 18, 2000 (65 FR 10061), minimal treatment of low-level radioactive waste will be performed at all sites, and, to the extent practicable, onsite disposal of low-level radioactive waste will continue. Hanford and NTS will be made available to all DOE sites for disposal of low-level radioactive waste. Mixed low-level radioactive waste analyzed in the *Waste Management PEIS* will be treated at Hanford, the Idaho National Engineering and Environmental Laboratory (INEEL), the Oak Ridge Reservation, and the Savannah River Site and will be disposed of at Hanford and NTS.

It is assumed in this EIS that low-level radioactive waste, mixed low-level radioactive waste, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current and developing site practices. No high-level radioactive waste or transuranic waste is generated from the activities conducted at TA-18.

No Action Alternative

The expected waste generation rates at LANL associated with maintaining the current missions at TA-18 for the 25-year operating period are compared with LANL's treatment, storage, and disposal capacities in **Table 5–17**. These waste generation rates are consistent with the Expanded Operations Alternative as described in the *LANL SWEIS* (DOE 1999b) and associated Record of Decision (64 FR 50797, September 20, 1999). The impacts on the LANL waste management systems, in terms of managing the waste, are discussed in this section. Radiological and chemical impacts on workers and the public from waste management activities are included in the public and occupational health and safety impacts provided in Section 5.2.10.

Solid low-level radioactive waste generated from activities conducted at TA-18 would continue to be characterized and packaged for disposal at the onsite low-level radioactive waste disposal facility at TA-54, Area G. About 3,600 cubic meters (4,700 cubic yards) of solid low-level radioactive waste would be generated over the 25-year operating period of maintaining activities at TA-18. This solid low-level radioactive waste represents about 1.4 percent of the current disposal capacity of the TA-54 Area G Low-Level Radioactive Waste Disposal Facility. As previously discussed in Section 4.2.12.2 of this EIS, as part of the implementation of the Expanded Operations Alternative (Preferred Alternative in the *LANL SWEIS*), the disposal capacity of the TA-54 Area G Low-Level Radioactive Waste Disposal Facility will be expanded into Zones 4 and 6 at Area G. The impacts of managing this waste at LANL would be minimal.

Table 5–17 Waste Management Impacts under the No Action Alternative

Waste Type [a]	*Estimated Waste Generation for TA-18 Mission Operations (cubic meters per year)*	*Estimated Waste Generation as a Percent of* [b]		
		Onsite Treatment Capacity	*Onsite Storage Capacity*	*Onsite Disposal Capacity*
Low-Level Radioactive Waste				
Liquids	0	0	0	0
Solids	145	Not applicable	Not applicable	1.4
Mixed Low-Level Radioactive Waste				
Liquids	0	0	0	0
Solids	1.5	Not applicable	6.4	Not applicable
Hazardous Waste				
Liquids	0	0	0	0
Solids	4 (4,000 kilograms per year)	Not applicable	Not applicable	Not applicable
Nonhazardous Waste				
Sanitary wastewater	14,600 (40,000 liters per day) [c]	1.8	Not applicable	Not applicable
Solids	0	0	0	0

[a] See definitions in Chapter 8.
[b] The estimated amounts of waste generated annually are compared with the annual site treatment capacities. The estimated total amounts of waste generated over the assumed 25-year operating period are compared with the site storage and disposal capacities.
[c] Based on the assumption of 212 workers generating 50 gallons per day.
Note: To convert from cubic meters per year to cubic yards per year, multiply by 1.308; to convert from kilograms to pounds, multiply by 2.2.
Not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on site, or is not held in long-term storage).

Mixed low-level radioactive waste generated from activities conducted at TA-18 would continue to be surveyed and decontaminated on site, if possible. The remaining waste would be stored on site and transported to a commercial or DOE offsite treatment and disposal facility. This waste would be managed in accordance with the LANL site treatment plan. About 38 cubic meters (50 cubic yards) of mixed low-level radioactive waste would be generated over the 25-year operating period of maintaining activities at TA-18. This mixed low-level radioactive waste represents about 6.4 percent of the current mixed low-level radioactive waste storage capacity at LANL. The impacts of managing this waste at LANL would be minimal.

Hazardous waste generated from activities conducted at TA-18 would continue to be decontaminated or recycled, if possible. The remaining waste would be packaged and shipped to offsite Resource Conservation and Recovery Act (RCRA)-permitted treatment and disposal facilities. Typically, hazardous waste is not held in long-term storage at LANL. The annual estimate of 4,000 kilograms (8,800 pounds) represents about 0.46 percent of the annual hazardous waste generation rate—860,000 kilograms (1,900,000 pounds) per year—for the entire LANL site. The impacts of managing this waste at LANL would be minimal.

Sanitary wastewater generated as a result of maintaining activities at TA-18 would continue to be sent to the Sanitary Wastewater Systems Consolidation Plant at TA-46. About 14,600 cubic meters (19,000 cubic yards) per year of sanitary wastewater would be generated from maintaining activities at TA-18. This sanitary wastewater would represent about 1.8 percent of the 2.27 million-liter-per-day design capacity of the Sanitary Wastewater Systems Consolidation Plant.

TA-18 Upgrade Alternative

Construction Impacts—As previously discussed in Section 4.2.12.1 of this EIS, potential release sites at TA-18 have been investigated and characterized. Most of the potential release sites have been recommended for no further action, following site characterization. Several potential release sites have undergone either interim or final remediation to remove contaminants and decrease the potential for future releases and migration off site. If it is determined that any potential release sites requiring remediation extend into the construction area, further actions, including appropriate documentation, would be completed under the environmental restoration program and in accordance with LANL's Hazardous Waste Facility Permit. Therefore, potential waste generated from such remediation activities is not included in the *TA-18 Relocation EIS* analyses.

Only hazardous and nonhazardous waste types are expected to be generated from the construction activities to modify TA-18 as described under the TA-18 Upgrade Alternative. No radioactive waste is expected to be generated. The impacts on the LANL waste management systems, in terms of managing the waste, are discussed in this section. Radiological and chemical impacts on workers and the public from waste management activities are included in the public and occupational health and safety impacts provided in Section 5.2.10.

Hazardous waste generated from construction activities to modify TA-18 would be decontaminated or recycled, if possible. The remaining waste would be packaged and shipped to off site RCRA-permitted treatment and disposal facilities. Typically, hazardous waste is not held in long-term storage at LANL. About 4,300 kilograms (9,500 pounds) per year of hazardous waste would be generated (LANL 2001a). This waste represents about 0.5 percent of the annual hazardous waste generation rate for the entire LANL site—860,600 kilograms (1,900,000 pounds) per year. The impacts of managing this waste at LANL would be minimal.

Solid nonhazardous waste generated from construction activities to modify TA-18 would be disposed of at the Los Alamos County Landfill located at LANL or its replacement facility offsite. Approximately 790 cubic meters (1,030 cubic yards) of solid nonhazardous waste, primarily steel, concrete, and other waste, would be generated from the construction activities (LANL 2001a). This waste represents about 14 percent of the current annual solid nonhazardous waste generation rates at LANL—5,453 cubic meters (7,100 cubic yards) per year. The impacts of managing this waste at LANL would be minimal.

Sanitary wastewater generated as a result of construction activities to modify TA-18 would be managed using portable toilet systems.

Operations Impacts—The impacts of managing waste associated with the operations of TA-18 under the TA-18 Upgrade Alternative would be the same as for the No Action Alternative. This is because waste generation during operations would not be affected by the proposed modifications to the facility, and, therefore, the same types and volumes of waste would be generated.

LANL New Facility Alternative

Construction Impacts—As previously discussed in Section 4.2.12.1 of this EIS, based on a review by LANL's Environmental Restoration Project, the boundary of Potential Release Site 48-001 overlaps a small area in the corner of the proposed relocation site at TA-55. This area of overlap involves possible surface soil contamination from TA-48 stack emissions. Before construction activities would begin in TA-55, LANL's Environmental Restoration Project would perform a radiological survey of the area inside the Potential Release Site 48-001 and the area of overlap into TA-55. The purpose of the survey would be to determine whether the Potential Release Site 48-001 extends into the construction area. Based on these survey results, if it is determined that the potential release site extends into the construction area, further actions, including appropriate documentation, would be completed under the environmental restoration program and in accordance with LANL's Hazardous Waste Facility Permit. Therefore, potential waste generated from such remediation activities is not included in the *TA-18 Relocation EIS* analyses.

Only nonhazardous waste is expected to be generated from the construction activities to relocate the TA-18 capabilities and materials to new buildings at TA-55 within LANL. No radioactive or hazardous waste is expected to be generated. The impacts on the LANL waste management systems, in terms of managing the waste, are discussed in this section. Radiological and chemical impacts on workers and the public from waste management activities are included in the public and occupational health and safety impacts provided in Section 5.2.10.

Solid nonhazardous waste generated from construction activities associated with the new building would be disposed of at the Los Alamos County Landfill located at LANL or its replacement facility off site. Approximately 83 cubic meters (108 cubic yards) of solid nonhazardous waste, consisting primarily of gypsum board, wood scraps, scrap metals, and concrete, would be generated from the construction activities (LANL 2001a). This waste represents about 1.5 percent of the current annual solid nonhazardous waste generation rates at LANL— 5,453 cubic meters (4,200 cubic yards) per year. The impacts of managing this waste at LANL would be minimal.

Sanitary wastewater generated as a result of construction activities would be managed using portable toilet systems.

Operations Impacts—The impacts of managing waste associated with operations under the LANL New Facility Alternative are assumed to be the same as for the No Action Alternative. This is because waste generation during operations would not be affected by the relocation of these activities to new facilities, and therefore, the same types and volumes of waste would be generated.

5.2.13 Transportation Impacts

Under the TA-18 Upgrade and the LANL New Facility Alternatives, all radioactive and special nuclear material (SNM) shipments would be conducted within the LANL site. Movement distances would vary from building to building to intrasite moves of several kilometers. Movement of materials would be over short distances on DOE-controlled roads. DOE procedures and U.S. Nuclear Regulatory Commission regulations would not require the use of a certified Type B casks within DOE sites. However, DOE procedures require closing the roads and stopping traffic for shipment of material (fissile or SNM) in noncertified packages. Shipment using certified packages, smaller quantities of radioactive materials and SNM, or depleted or natural uranium shielding, could be performed while site roads are open. For the open-road operations, no incident-free public risk analysis was conducted because the public would receive no measurable exposure to radiological materials. For the TA-18 Upgrade Alternative, the dose to site workers would be the result of miscellaneous SNM movement to support facility upgrades. For the LANL New Facility Alternative, the radiological dose to site workers would include exposure during packaging and loading of SNM and other related materials at TA-18, transport to TA-55, and unloading and unpacking at TA-55. The dose to site workers under the TA-18 Upgrade Alternative would be about 0.25 person-rem, which corresponds to less than 0.0001 latent cancer fatalities. The dose to site workers under the LANL New Facility Alternative would be 2.3 person-rem, which corresponds to 0.0009 latent cancer fatalities. Dose estimates are described in Appendix D, Section D.7.9. Accident analyses are not necessary because potential accidents during the movement would be bounded in frequency and consequence by facility accidents, presented in Section 5.2.10.2. Once a transportation package is closed for low-speed movement to a nearby facility, the likelihood and consequence of any foreseeable accident were considered to be very small and were not quantified. The dose to site workers from transporting SHEBA and related materials to TA-39 is described in Section 5.6.3.13.

5.2.14 Cumulative Impacts

As previously discussed, impacts associated with the Expanded Operations Alternative presented in the *LANL SWEIS* provide the basis for the No Action Alternative impacts presented in this *TA-18 Relocation EIS*. The No Action Alternative, in turn, provides the baseline from which incremental effects of the proposed action at LANL are measured. The projected incremental environmental impacts of implementing the proposed actions at LANL were added to the environmental impacts of other present and reasonably foreseeable future actions at or near LANL to obtain cumulative site impacts under normal operations.

Most of the ongoing and reasonably foreseeable future actions planned for LANL have already been addressed in the *LANL SWEIS* and are included in the No Action Alternative presented in Section 5.2. Reasonably foreseeable future actions addressed in the *LANL SWEIS* include expansion of the TA-54/Area G low-level radioactive waste disposal area and enhancement of plutonium pit manufacturing. Impacts from other reasonably foreseeable future actions at LANL include those presented in the *LANL SWEIS* and the *Atlas Relocation and Operation at the Nevada Test Site* (DOE 2001c), which are described along with other relevant National Environmental Policy Act (NEPA) reviews in Sections 1.4.1.6 and 1.4.1.14, respectively. The proposed action for the relocation of Atlas to NTS involves the disassembly of the Atlas Facility and machine at LANL and transport to NTS. The contribution to cumulative impacts from the disassembly of the Atlas Facility at LANL is expected to be negligible. Impacts from these actions were factored into estimates of total cumulative impacts, where possible, for the potentially affected resource areas presented in this section.

Cumulative transportation impacts were determined by analyzing the impacts along the various routes used to transport the materials associated with relocated TA-18 activities over the 25-year operating period. The methodology for assessing cumulative impacts is presented in Appendix F.

In this section, cumulative site impacts are presented only for those "resources" at a site that reasonably may be expected to be affected by the proposed action. These include electrical consumption, water usage, air quality, waste management, and public and occupational health and safety. This section also includes the cumulative impacts associated with intersite transportation.

Resource Requirement Impacts—As previously discussed in Section 5.2.2, site electrical capacity in terms of electric peak load and the available site water capacity could be exceeded in the future even in the absence of any new demands associated with TA-18 relocation activities. This potential exists based on the projected infrastructure requirements to implement the *LANL SWEIS* Expanded Operations Alternative and the forecasted demands of other non-LANL users. Should these projections be fully realized over the 25-year time frame analyzed in this document, LANL could cumulatively require 121 percent of the current peak load capacity, 97 percent of its total available electrical capacity, and 141 percent of the available water capacity. Thus, additional peak load and water supply capacity would be needed. As a worst-case alternative, implementation of the LANL New Facility Alternative under this scenario would account for about 2 percent of both the site's use of electric peak load and total electrical capacity, with no expected net increase in water use. No infrastructure capacity constraints are anticipated in the near term, as LANL operational demands to date on key infrastructure resources, including electricity and water, have been well below projected levels and well within site capacities. Any potential shortfalls in available capacity would be addressed as increased site requirements are realized.

Air Quality Impacts—Cumulative impacts on air quality at LANL would be the same as discussed in the *LANL SWEIS*, except that during the annual 24-hour testing of the emergency diesel generator, elevated concentrations of nitrogen dioxide may occur along Pajarito Road. Since the 24-hour nitrogen dioxide standard value can be exceeded once per year, one day of testing would not be expected to result in an exceedance of the standard, even under the conservative modeling assumptions used in evaluating the impact of these generators. As such, LANL would continue to be in compliance with all Federal and state ambient air quality standards. The contribution to cumulative air quality impacts from the disassembly of the Atlas Facility at LANL is expected to be minor.

Public and Occupational Health and Safety – Normal Operations Impacts—Cumulative impacts in terms of radiation exposure to the public and workers at LANL would be within the level of impacts forecast under the Expanded Operations Alternative described in the *LANL SWEIS*. The contribution to cumulative public and occupational health and safety impacts from the disassembly of the Atlas Facility at LANL is expected to be minor. There would be no increase expected in the number of latent cancer fatalities in the population from site operations if TA-18 operations were to occur at LANL. The dose limits for individual members of the public are given in DOE Order 5400.5. As discussed in that order, the dose limit from airborne emissions is 10 millirem per year, as required by the Clean Air Act; the dose limit from drinking water is 4 millirem per year, as required by the Safe Drinking Water Act; and the dose limit from all pathways combined is 100 millirem per year. Therefore, the dose to the maximally exposed offsite individual would be expected to remain well within the regulatory limits. Onsite workers would not be expected to have any increase in the number of latent cancer fatalities due to radiation from TA-18 operations over the 25-year operating period.

Waste Management Impacts—Cumulative amounts of waste generated at LANL from TA-18 operations would remain within the level of impacts forecast under the Expanded Operations Alternative described in the *LANL SWEIS*. In addition, the refurbishment of criticality machines associated with the relocation of TA-18 missions would generate less than 6.4 metric tons (7 tons), or about 1.5 cubic meters (2 cubic yards), of low-level radioactive and mixed low-level radioactive waste. This one-time generation of waste would consist of old electrical racks, hydraulic systems, control cartridges, and machine stands that would be replaced by new components as part of TA-18 mission relocation activities. It is unlikely that this refurbishment would be a major impact on waste management at LANL because sufficient capacity exists to manage the site waste. The contribution to cumulative waste management impacts from the disassembly of the Atlas Facility at LANL is expected to be minor.

Transportation Impacts—The cumulative impacts from transportation associated with the relocation of TA-18 operational capabilities and materials are identified in Appendix D. Because likely transportation routes cross many states, cumulative impacts are compared on a national basis. Under the LANL alternatives assessed in this *TA-18 Relocation EIS*, occupational radiation exposure to transportation workers and exposure to the public are estimated to represent less than 0.01 percent of the cumulative exposures from nationwide transportation (DOE 1999d). No additional traffic fatality is expected; the incremental increase in traffic fatalities would be less than 0.0001 percent per year.

5.3 SNL/NM Alternative

Section 5.3 discusses the environmental impacts associated with the relocation of the TA-18 operational capabilities and materials to the SNL/NM site. As discussed in Section 3.3.4, the relocation would involve only security Category I/II activities. The environmental impacts associated with the relocation of SHEBA activities and other security Category III/IV activities are discussed separately in Section 5.6.

Under the SNL/NM Alternative, the TA-18 operational capabilities and materials associated with security Category I/II activities would be relocated to a new facility building to be constructed at SNL/NM. The alternative also involves internal modifications and upgrades of existing buildings at SNL/NM to support the security Category I/II activities (see Section 3.3.4). The Expanded Operations Alternative presented in the *Sandia National Laboratories/New Mexico Final Site-Wide Environmental Impact Statement* (*SNL/NM SWEIS*) (DOE 1999f) provides the baseline from which incremental effects of the proposed action at SNL/NM are measured.

5.3.1 Land Resources

5.3.1.1 Land Use

Construction Impacts—Under this alternative, approximately 1.8 hectares (4.5 acres) of land would be disturbed by construction of a new underground facility at TA-V. The building could be constructed southeast or southwest of the Sandia Pulsed Reactor Building. Both locations would require the relocation of the current TA-V Perimeter Intrusion Detection and Assessment System (PIDAS). Realigning the PIDAS would enclose up to 5 additional hectares (12.4 acres) of TA-V within the security fence. In addition, 10 existing aboveground buildings would be modified or renovated to meet TA-18 relocation requirements. Construction of new buildings and modification or renovation of existing buildings would be compatible with current land use within TA-V.

Operations Impacts—Operations of a new underground facility and modified existing buildings would be compatible with current activities at TA-V. Thus, there would be no impact on land use during the operational phase of the proposed action.

5.3.1.2 Visual Resources

Construction Impacts—Activities related to the construction of a new underground facility for TA-18 missions would result in a change to the visual appearance of TA-V due to the presence of construction equipment and possibly increased dust. These changes would be temporary and, due to the isolated location of TA-V, likely would not be noticeable from areas off Kirtland Air Force Base (KAFB). Most changes to the 10 existing buildings also required to support TA-18 operations would be internal with only minor external changes.

Operations Impacts—Once operational, a new underground facility building would be covered with soil and revegetated with grasses, and modifications to the 10 buildings required to support TA-18 operations would result in little change in the appearance of the area. Thus, the current Class IV Bureau of Land Management Visual Resource Management rating of TA-V would not change and there would be no impact on visual resources at the site.

5.3.2 Site Infrastructure

Construction Impacts—The projected demands on key site infrastructure resources associated with site construction under this alternative on an annualized basis are presented in **Table 5–18**. Existing KAFB infrastructure would easily be capable of supporting the construction requirements for the new underground facility and modifications to existing facilities at SNL/NM proposed under this alternative without exceeding site capacities. Although gasoline and diesel fuel would be required to operate construction vehicles, generators, and other construction equipment, fuel would be procured from offsite sources and, therefore, would not be a limited resource. Impacts on the local transportation network are expected to be negligible.

Table 5–18 Annual Site Infrastructure Requirements for Facility Construction under the SNL/NM Alternative

Resource	*Available Site Capacity* [a]	*SNL/NM Alternative*	
		Requirement	*Percent of Available Site Capacity*
Electricity			
Energy (megawatt-hours per year)	596,000.00	128	0.02
Peak load (megawatts)	56	0.13	0.2
Fuel			
Natural gas (cubic meters per year)	29,400,000.00	0	0
Gasoline and diesel fuel (liters per year) [b]	Not limited	Negligible	Negligible
Water (liters per year)	3,200,000,000.00	17,000,000.00	0.5

[a] Capacity minus the current site requirements, a calculation based on the data provided in Table 4–19, *TA-18 Relocation EIS*.
[b] Not limited due to offsite procurement.
Sources: Table 4–19, *TA-18 Relocation EIS*; SNL/NM 2001a.

Operations Impacts—Resources needed to support operations under the SNL/NM Alternative are presented in **Table 5–19**. It is projected that existing KAFB and SNL/NM infrastructure resources would be adequate to support proposed mission activities over 25 years. In general, infrastructure requirements under this alternative would approximate those of the LANL New Facility Alternative.

Table 5–19 Annual Site Infrastructure Requirements for Facility Operations under the SNL/NM Alternative

Resource	*Available Site Capacity* [a]	*SNL/NM Alternative*	
		Requirement	*Percent of Available Site Capacity*
Electricity			
Energy (megawatt-hours per year)	596,000	21,000	3.5
Peak load (megawatts)	56	3	5.4
Fuel			
Natural gas (cubic meters per year)	29,400,000	Negligible	Negligible
Liquid fuels (liters per year) [b]	Not limited	Negligible	Negligible
Coal (metric tons per year)	Not applicable	0	Not applicable
Water (liters per year)	3,200,000,000	6,900,000	0.2

[a] Capacity minus the current site requirements, a calculation based on the data provided in Table 4–19, *TA-18 Relocation EIS*.
[b] Not limited due to offsite procurement.
Sources: Table 4–19, *TA-18 Relocation EIS*; SNL/NM 2001a.

5.3.3 Air Quality

5.3.3.1 Nonradiological Releases

Construction Impacts—Construction of new buildings and modification of existing buildings at TA-V would result in an increase in air quality impacts from construction equipment, trucks, and employee vehicles. Criteria pollutant concentrations for construction were modeled and compared to the most stringent standards (see **Table 5–20**). The maximum ground-level concentrations that would result from construction would be well below the ambient air quality standards. The maximum concentrations would occur at the SNL/NM site boundary west-northwest of TA-V. Modeling of construction air quality considered particulate emissions from activity in a construction area of 1.8 hectares (4.5 acres) for security Category I/II activities and emissions from various earthmoving and materials-handling equipment.

Table 5–20 Nonradiological Air Quality Concentrations at the Site Boundary under the SNL/NM Alternative – Construction

	Averaging Period	*Most Stringent Standard or Guideline (micrograms per cubic meter)* [a]	*Maximum Incremental Concentration (micrograms per cubic meter)* [b]
Carbon monoxide	8 Hours 1 Hour	8,280 12,500	3.77 30.2
Nitrogen dioxide	Annual 24 Hours	78.1 156	0.003 3.43
PM_{10}	Annual 24 Hours	50 150	0.055 4.82
Sulfur dioxide	Annual 24 Hours 3 Hours	43.5 217 1,090	less than 0.001 0.469 3.75
Total suspended particulates	Annual 24 Hours	60 150	0.11 9.31

PM_{10} = particulate matter less than or equal to 10 microns in diameter.

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean PM_{10} standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard. Standards and monitored values for pollutants other than particulate matter are stated in parts per million. These values have been converted to micrograms per cubic meter with appropriate corrections for temperature (21 °C [70 °F]) and pressure (elevation 1,600 meters [5,400 feet]), following New Mexico dispersion modeling guidelines (revised 1998) (NMAQB 1998).

[b] The concentrations were analyzed at locations to which the public has access—the site boundary, nearby sensitive areas, and onsite military housing.

Sources: 40 CFR 50, DOE 1999f, SNL/NM 2001a.

Operations Impacts—Under the SNL/NM Alternative, small quantities of criteria and toxic air pollutants would be generated from the operation of the emergency diesel generators and other activities. The emissions from the generators would be independent of the activities being performed at TA-V, since they result primarily from periodic testing. **Table 5–21** summarizes the concentrations of criteria pollutants from operation of the diesel generators. The concentrations are compared to their corresponding ambient air quality standards. The maximum concentrations that would result from operations would occur along the SNL/NM boundary to the west-northwest to southwest. No major change in emissions or air pollutant concentrations is expected under this alternative. Therefore, a Prevention of Significant Deterioration increment analysis is not required (see Appendix F, Section F.3.1). SNL/NM is located in an attainment area for criteria air pollutants and a maintenance area for carbon monoxide. Since the area is a maintenance area for carbon monoxide and emissions of carbon monoxide are below the applicability level of 91 metric tons (100 tons) per year for maintenance areas, no conformity analysis is required (see Appendix F, Section F.3.2).

5.3.3.2 Radiological Releases

Construction Impacts—While no radiological releases to the environment are expected in association with construction activities at TA-V, the potential exists for contaminated soils and possibly other media to be disturbed during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any contamination and would be required to remediate any contamination in accordance with procedures established under SNL/NM's environmental restoration program.

Table 5–21 Nonradiological Air Quality Concentrations at the Site Boundary under the SNL/NM Alternative – Operations

	Averaging Period	*Most Stringent Standard or Guideline (micrograms per cubic meter)* [a]	*Maximum Incremental Concentration (micrograms per cubic meter)* [b]
Carbon monoxide	8 Hours 1 Hour	8,280 12,500	1.23 9.59
Nitrogen dioxide	Annual 24 Hours	78.1 156	less than 0.001 2.22
PM_{10}	Annual 24 Hours	50 150	less than 0.001 0.158
Sulfur dioxide	Annual 24 Hours 3 Hours	43.5 217 1,090	less than 0.001 0.147 1.0
Total suspended particulates	Annual 24 Hours	60 150	less than 0.001 0.158

PM_{10} = particulate matter less than or equal to 10 microns in diameter.

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Air Ambient Air Quality Standards (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean PM_{10} standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard. Standards and monitored values for pollutants other than particulate matter are stated in parts per million. These values have been converted to micrograms per cubic meter with appropriate corrections for temperature (21 °C [70 °F]) and pressure (elevation 1,600 meters [5,400 feet]), following New Mexico dispersion modeling guidelines (revised 1998) (NMAQB 1998).

[b] The concentrations were analyzed at locations to which the public has access—the site boundary, nearby sensitive areas, and onsite military housing.

Sources: 40 CFR 50, DOE 1999f, SNL/NM 2001a.

Operations Impacts—Approximately 10 curies per year of argon-41 would be released from the relocated TA-18 operational capabilities and materials at SNL/NM (see Section 3.2.1). There would be no other radiological releases from the relocated mission activities. Impacts from radiological releases are described in Section 5.3.10.1.

5.3.4 Noise

Construction Impacts—Construction of new buildings and modification of buildings at SNL/NM's TA-V would result in some temporary increase in noise levels near the area from construction equipment and activities. Some disturbance of wildlife near the area may occur as a result of operation of construction equipment. There would be no change in noise impacts on the public as a result of construction activities, except for a small increase in traffic noise levels from construction employees and material shipments along routes leading to SNL/NM. Noise sources associated with construction at TA-V are not expected to include loud impulsive sources such as blasting.

Operations Impacts—Noise impacts from operations of new buildings at TA-V are expected to be similar to these from existing operations at TA-V. Although there would be a small increase in traffic and equipment noise (e.g., heating and cooling systems, generators, etc.) near the area, there would be little change in noise impacts on wildlife and little increase in noise impacts on the public outside of SNL/NM as a result of moving security Category I/II activities to SNL/NM.

5.3.5 Geology and Soils

Construction Impacts—Construction activities under the SNL/NM Alternative are expected to disturb a total of approximately 1.8 hectares (4.5 acres) of currently vacant land located just southeast or southwest of the Sandia Pulsed Reactor Facility within TA-V. Aside from additional renovations of existing structures, this disturbance would be associated with the construction of a new underground facility building, with the facility size and total land disturbance approximating that associated with the LANL New Facility Alternative. Although aggregate and other geologic resources (e.g., sand) would be required to support construction activities at TA-V, these resources are abundant throughout the Albuquerque-Belen Basin. Also, as blasting should not be necessary due to the relatively unconsolidated nature of the subsurface strata, and because the land area to be disturbed is relatively small, the impact on geologic and soil resources would be relatively minor overall. A site survey and foundation study would be conducted as necessary to confirm site geologic characteristics for facility engineering purposes. The potential also exists for contaminated soils and possibly other media to be encountered during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any contaminated media and remediation required in accordance with the procedures established under the site's environmental restoration program.

As discussed in Section 4.3.5, KAFB and SNL/NM are located in a region with relatively moderate to high seismicity. Ground shaking of Modified Mercalli Intensity VII (see Appendix F, Table F–6) associated with postulated earthquakes is possible and supported by the historical record for the region. Modified Mercalli Intensity VII ground shaking would be expected to affect primarily the integrity of inadequately designed or nonreinforced structures, but damage to properly or specially designed or upgraded facilities would not be expected. Although mapped faults cross KAFB just to the east of TA-V, none are currently considered capable. The potential for other large-scale geologic hazards to affect TA-V facilities is also low.

As stated in DOE Order 420.1, DOE is required to ensure that nuclear and nonnuclear facilities be designed, constructed, and operated so that workers, the public, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes.

Operations Impacts—The operations of the new and modified buildings under this alternative would not be expected to result in impacts on geologic and soil resources at SNL/NM. As discussed above, the proposed new underground facility building and renovated buildings would be evaluated, designed, and constructed in accordance with DOE Order 420.1 and sited to minimize the risk from geologic hazards. Thus, site geologic conditions would not likely affect the facilities.

5.3.6 Water Resources

5.3.6.1 Surface Water

Construction Impacts—Surface water would not be used to support the construction of the new underground facility building or renovations of existing buildings at SNL/NM's TA-V. Groundwater is the source of water at SNL/NM. There are no natural surface water drainages in the vicinity of TA-V, although a drainage ditch conveys storm-water runoff to Arroyo del Coyote located just to the northeast of TA-V. This arroyo is not perennial and is not a viable source of surface water. Therefore, there would be no construction impact on surface water availability. Sanitary wastewater would be generated by construction personnel. As plans include the use of portable toilets, there would be no onsite discharge of sanitary wastewater and no impact on surface waters. Waste generation and management activities are detailed in Section 5.3.12.

Storm-water runoff from construction areas could potentially impact downstream surface water quality, especially if points of disturbance or construction lay-down areas are located in proximity to storm drains or collector ditches leading to Arroyo del Coyote. However, effects on runoff quality likely would be very localized and of short duration. Appropriate soil erosion and sediment control measures (e.g., sediment fences, stacked haybales, mulching disturbed areas, etc.) and spill prevention practices would be employed during construction to minimize suspended sediment and material transport and potential water quality impacts. TA-V is not in an area prone to flooding.

Operations Impacts—No impacts on surface water resources are expected as a result of operations at TA-V under this alternative. No surface water would be used to support facility activities and there would be no direct discharge of sanitary or industrial effluent to surface waters. Sanitary wastewater would be generated as a result of facility operations stemming from facility staff use of lavatory, shower, and break-room facilities, and from miscellaneous potable and sanitary uses. Nevertheless, it is planned that this wastewater would be collected and conveyed to existing wastewater treatment facilities. In addition, no industrial or other NPDES-regulated discharges to surface waters are anticipated. Waste generation and management activities are detailed in Section 5.3.12. Overall, operational impacts on site surface waters and downstream water quality would be expected to be negligible.

5.3.6.2 Groundwater

Construction Impacts—Water would be required during construction for such uses as dust control and soil compaction, washing and flushing activities, and to meet the potable and sanitary needs of construction employees. Water use by construction personnel would be greatly reduced over that normally required by the proposed use of portable toilets. In addition, concrete and the water required for concrete mixing would likely be procured off site. As a result, it is estimated that construction activities would require approximately 17 million liters (4.5 million gallons) of groundwater on an annualized basis (see Table 5–18) to support new facility construction and renovations to existing facilities. It is currently anticipated that this water would be derived from the KAFB groundwater distribution system serving SNL/NM via a temporary service connection or trucked to the point of use, especially during the early stages of construction. The relatively small volume of groundwater required during the period of construction compared to site availability and historic usage indicates that construction withdrawals should not have an additional impact on regional groundwater levels or availability. Excavation associated with construction of the underground SNM facility building would not be expected to affect groundwater quality or flow, as the depth of groundwater is generally greater than 100 meters (330 feet). Thus, construction dewatering is not expected to be required.

There would be no onsite discharge of wastewater to the surface or subsurface, and appropriate spill prevention controls, countermeasures, and procedures would be employed to minimize the chance for petroleum, oils, lubricants, and other materials used during construction to be released to the surface or subsurface and to ensure that waste materials are properly disposed of. Waste generation and management activities are detailed in Section 5.3.12. In general, no impact on groundwater availability or quality is anticipated.

Operations Impacts—Facilities housing the relocated TA-18 operations at TA-V under the SNL/NM Alternative would use groundwater primarily to meet the potable and sanitary needs of facility support personnel as well as for miscellaneous building mechanical uses. It is estimated that about 6.9 million liters (1.8 million gallons) of water would be required annually for facility operations. As this demand would be a small fraction of existing KAFB usage and would not exceed site availability (see Table 5–19), no additional measurable impact on regional groundwater levels or availability would be anticipated.

No sanitary or industrial effluent would be directly discharged to the surface or subsurface. Waste generation and management activities are detailed in Section 5.3.12. Thus, no operational impacts on groundwater quality would be expected.

5.3.7 Ecological Resources

5.3.7.1 Terrestrial Resources

Construction Impacts—Under this alternative, approximately 1.8 hectares (4.5 acres) of land would be disturbed by construction of the new underground facility building. The building could be constructed southeast or southwest of the Sandia Pulsed Reactor Building. Both locations would require the relocation of the current TA-V PIDAS. Realigning the PIDAS would enclose up to 5 additional hectares (12.4 acres) of TA-V within the security fence. The area on which the facility building would be constructed is covered by grassland; however, grasslands are common on KAFB, and the area lost represents a small percentage of this habitat type present within the immediate area or on KAFB as a whole.

Wildlife using the site proposed for a new underground facility would be lost or displaced by construction. Wildlife so affected would primarily include species common to grasslands, but would also include animals found within the disturbed portions of TA-V, such as the European starling, house sparrow, and small mammals. Once the new underground facility is complete, it would be covered with earth and revegetated with grasses. Thus, a portion of the area would be available to some of the same species displaced by construction. Noise associated with earthmoving activities and construction could cause temporary disturbance to wildlife found in areas adjacent to the construction site; however, such disturbance would be temporary. Since all activities would take place within a defined construction zone, direct human disturbance to wildlife and wildlife habitat outside of that zone, such as might be caused by the movement of equipment, would not occur.

Operations Impacts—Operations of facilities associated with relocated TA-18 operations would not be expected to impact either wildlife or wildlife habitat at SNL/NM because relocated TA-18 operations would not produce emissions or effluent of quality or at levels that would likely affect wildlife.

5.3.7.2 Wetlands

Construction and Operations Impacts—Since there are no wetlands located within or adjacent to TA-V, construction and operations of the new underground facility would not impact this resource. For the same reason, modification or renovation of the 10 existing buildings at TA-V also would not have an impact on wetlands.

5.3.7.3 Aquatic Resources

Construction and Operations Impacts—Since there are no aquatic resources located within or immediately adjacent to TA-V, construction and operations of a new underground facility building would not impact this resource. For the same reason, modification or renovation of the 10 existing buildings at TA-V also would not have an impact on aquatic resources. Normal erosion and sediment control measures would be implemented during both construction and operations, thus preventing uncontrolled runoff from leaving the site and impacting more distant aquatic systems.

5.3.7.4 Threatened and Endangered Species

Construction and Operations Impacts—Under the SNL/NM Alternative, there would be no impacts on threatened and endangered species at TA-V from construction because no threatened or endangered species occur within the region of influence. Operations impacts would not impact threatened and endangered species because relocated TA-18 operations would not produce emissions or effluent of a quality or at levels that would likely affect these species.

5.3.8 Cultural and Paleontological Resources

5.3.8.1 Prehistoric Resources

Construction and Operations Impacts—TA-V has been completely inventoried for prehistoric sites (see Section 4.3.8.1) and none have been found. Thus, it is unlikely that these resources would be impacted by construction and operations of the new underground facility building and modification or renovation of the 10 buildings required to support TA-18 operations. Nevertheless, prior to construction, a cultural resource survey of areas to be disturbed would be conducted and site mitigations would be applied, if needed. If prehistoric resources were discovered during construction, all work potentially affecting the resources would stop. This work stoppage would be followed by investigations by qualified cultural resource specialists; any coordination necessary with the State Historic Preservation Office; and development and implementation of measures to salvage these resources.

5.3.8.2 Historic Resources

Construction and Operations Impacts—As is the case for prehistoric resources, TA-V has been completely inventoried for historic sites (see Section 4.3.8.2), with negative results. Assessments of buildings at TA-V for inclusion in the National Register of Historic Places have not been made, since structures located there are less than 50 years old. Thus, impacts on historic structures at TA-V would not be expected under this alternative.

5.3.8.3 Native American Resources

Construction and Operations Impacts—Traditional cultural properties have not been identified within TA-V (nor on KAFB as a whole), nor have any prehistoric or historic resources related to Native Americans been discovered within the site (see Sections 4.3.8.1 and 4.3.8.2). Thus, impacts on Native American resources resulting from the relocation of TA-18 operations at TA-V would not be expected. However, as noted in Section 5.3.8.1, if any such resources were located during construction, work would stop while appropriate action was taken.

5.3.8.4 Paleontological Resources

Construction and Operations Impacts—Palentological resources would not be affected by construction or operations of relocated TA-18 operational capabilities and materials at TA-V, since such resources have not been found in the area.

5.3.9 Socioeconomics

Construction Impacts—Construction of a new underground facility building and modifications to existing buildings at TA-V would require a peak construction employment level of 300 workers. This level of employment would generate about 1,149 indirect jobs in the region around SNL/NM. The potential total employment increase of 1,449 direct and indirect jobs represents an approximate 0.4 percent increase in the workforce and would occur only over the 16 months of construction. It would have no noticeable impact on the socioeconomic conditions of the region of influence.

Operations Impacts—Relocation of TA-18 operational capabilities and materials associated with security Category I/II activities to SNL/NM could result in the permanent relocation or hiring of approximately 20 new employees and a small reduction in employment levels at LANL. This level of employment would generate about 77 indirect jobs in the region around SNL/NM. The potential total employment increase of

97 direct and indirect jobs represents an approximate 0.03 percent increase in the workforce. It would have no noticeable impact on the socioeconomic conditions of the region of influence.

5.3.10 Public and Occupational Health and Safety

The assessments of potential radiological impacts associated with the SNL/NM Alternative are presented in this section. No chemical-related health impacts are associated with any of these alternatives because only very small quantities of industrial-type chemicals, such as ethanol, isopropyl alcohol, magnesium oxide, phenylphosphine, and xylene, would be used. As stated in the *LANL SWEIS* (DOE 1999b), the quantities of these chemicals that could be released to the atmosphere during normal operations are minor and would be below the screening levels used to determine the need for additional analysis. There would be no operational increase in the use of these chemicals as a result of the proposed action. No chemicals have been identified that would be a risk to members of the public from construction activities associated with the SNL/NM Alternative. Construction workers would be protected from hazardous chemicals by adherence to OSHA and EPA occupational standards that limit concentrations of potentially hazardous chemicals. The potential occupational (industrial) impacts on workers during construction and operations were evaluated based on DOE and Bureau of Labor statistic data and are detailed in Section C.7 of Appendix C. Construction and operations activities under this alternative are expected to result in some injuries but no fatalities to workers for the duration of the proposed action (i.e., about 3 years of construction and 25 years of operations).

Summaries of radiological impacts from normal operations and postulated accidents are presented below. The methodologies used to determine the impacts on the public and facility workers are presented in Appendix B. Supplemental information associated with normal operations and postulated accidents is provided in Appendices B and C, respectively.

5.3.10.1 Construction and Normal Operations

Construction Impacts—No radiological risks would be incurred by members of the public from construction activities. Construction workers may be at a small risk. They could receive doses above natural background radiation levels from exposure to radiation from other past or present activities at the site. However, these workers would be protected through appropriate training, monitoring, and management controls. Their exposures would be limited to ensure that doses were kept as low as is reasonably achievable.

Operations Impacts—Under this alternative, the only radiological release would be 10 curies per year of argon-41 to the atmosphere from Godiva operations (see Section 5.3.3.2). The associated calculated impacts on the public are presented in **Table 5–22**. The only dose pathway for receptors is from immersion in the passing plume. To put the doses into perspective, comparisons with natural background radiation levels are included in the table.

As shown in the table, the expected annual radiation dose to the maximally exposed offsite individual member of the public would be much smaller than the limit of 10 millirem per year set by both the EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The risk of a cancer fatality to this individual from annual operations would be approximately 1.6×10^{-10} (i.e., about 1 chance in 6 billion per year of a latent cancer fatality). The projected number of fatal cancers to the population within 80 kilometers (50 miles) would be 1.0×10^{-5} per year (i.e., about 1 chance in 100,000 per year of a latent cancer fatality).

Table 5–22 Annual Radiological Impacts on the Public from TA-18 Operations at SNL/NM

Receptor	*Impact Values*
Population within 80 Kilometers (50 Miles)	
Collective dose (person-rem)	0.020
Percent of natural background radiation [a]	8.1×10^{-6}
Cancer fatalities [b]	1.0×10^{-5}
Maximally Exposed Offsite Individual	
Dose (millirem)	0.00032
Percent of regulatory dose limit [c]	0.0032
Percent of natural background radiation [a]	9.6×10^{-5}
Cancer fatalities risk [b]	1.6×10^{-10}
Average Individual within 80 Kilometers (50 Miles)	
Dose (millirem)	2.7×10^{-5}
Percent of natural background radiation [a]	8.1×10^{-6}
Cancer fatalities risk [b]	1.3×10^{-11}

[a] The average annual dose from background radiation at SNL/NM is 332 millirem (see Section 4.3.11.1); the 745,287 people living within 80 kilometers (50 miles) of the TA-V site would receive an annual dose of 247,000 person-rem from the background radiation.

[b] Based on a cancer risk estimate of 0.0005 latent cancer fatalities per person-rem (see Appendix B).

[c] This comparison cannot be made for the population and average individual because there is no standard or limit.

Annual radiological doses to the 100 workers involved with TA-18 operations at TA-V under this alternative would average 100 millirem per worker, for a total workforce annual dose of 10 person-rem. The annual doses to individual workers would be well below the DOE limit of 5,000 millirem (10 CFR 835); the DOE Control Level of 1,000 millirem per year, as established in 10 CFR 835.1002; and the recommended Administrative Control Level of 500 millirem (DOE 1999e). An individual worker's annual risk of a fatal cancer is projected to be 4.0×10^{-5} (i.e., about 1 chance in 25,000 per year of a latent cancer fatality), and the projected number of fatal cancers in the workforce from operations would be 0.0040 per year (or 1 chance in 250 that the workers would experience a fatal cancer per year of operations).

5.3.10.2 Facility Accidents

Under the SNL/NM Alternative, TA-18 operational capabilities and materials associated with security Category I/II activities would be relocated to a new underground facility building to be constructed and the 10 existing aboveground buildings that would be modified or renovated within TA-V. The new buildings would include safety features that would reduce the risks of accidents that currently exist at LANL under the No Action Alternative. From an accident perspective the proposed new facility building would be an underground structure that meets performance category 3 seismic requirements and has a full confinement system that includes a tiered pressure zone ventilation and high-efficiency particulate air filters. The accident scenarios described for the No Action Alternative at LANL are considered applicable to the SNL/NM new facility, with one exception. Accidents associated with SHEBA are excluded because the SHEBA missions would be moved to LANL's TA-39; its impacts are shown in Section 5.6.3.10. Certain scenario parameter values applicable to the No Action Alternative, such as leak path factors, materials at risk, and the corresponding source term, have been adjusted to reflect improved safety features of the new facility.

Radiological Impacts—**Table 5–23** shows the frequencies and consequences of the postulated set of accidents for a noninvolved worker and the public (the maximally exposed offsite individual and the general population living within 80 kilometers [50 miles] of the facility). **Table 5–24** shows the accident risks, obtained by multiplying the consequences by the likelihood (frequency per year) that an accident could occur. The accidents listed in these tables were selected from a wide spectrum of accidents described in the *TA-18 BIO* (DOE 2001a). The selection process and screening criteria used (see Appendix C) ensure that the accidents chosen for evaluation in this EIS bound the impacts of all reasonably foreseeable accidents that could occur at TA-18 facilities. Thus, in the event that any other accident not evaluated in this EIS were to occur, its impacts on workers and the public would be expected to be within the range of the impacts evaluated.

Table 5–23 Accident Frequency and Consequences under the SNL/NM Alternative

		Maximally Exposed Offsite Individual		*Offsite Population* [a]		*Noninvolved Worker*	
	Frequency (per year)	*Dose (rem)*	*Latent Cancer Fatalities* [b]	*Dose (person-rem)*	*Latent Cancer Fatalities* [c]	*Dose (rem)*	*Latent Cancer Fatalities* [b]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core accident							
	1.0×10^{-6}	0.00087	4.4×10^{-7}	5.3	0.0026	0.572	0.00023
Bare, fully reflected or moderated metal criticality accident							
	1.0×10^{-4}	3.2×10^{-11}	1.6×10^{-14}	1.5×10^{-7}	7.4×10^{-11}	9.9×10^{-9}	4.0×10^{-12}
High-pressure spray fire on a Comet machine with a plutonium core							
	1.0×10^{-6}	0.033	1.7×10^{-5}	433	0.216	6.91	0.0028
Earthquake-induced facility failures without fire accident							
	1.0×10^{-4}	3.7×10^{-5}	1.8×10^{-8}	0.291	0.00015	0.026	1.0×10^{-5}

[a] Based on a population of 745,287 persons residing within 80 kilometers (50 miles) of the site.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

Table 5–24 Annual Cancer Risks Due to Accidents under the SNL/NM Alternative

Accident	*Maximally Exposed Offsite Individual* [a]	*Offsite Population* [b, c]	*Noninvolved Worker* [a]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	4.4×10^{-13}	2.6×10^{-9}	2.3×10^{-10}
Bare, fully reflected or moderated metal criticality	1.6×10^{-18}	7.4×10^{-15}	4.0×10^{-16}
High-pressure spray fire on a Comet machine with a plutonium core	1.7×10^{-11}	2.2×10^{-7}	2.8×10^{-9}
Earthquake-induced facility failures without fire	1.8×10^{-12}	1.5×10^{-8}	1.0×10^{-9}

[a] Increased risk of a latent cancer fatality.
[b] Risk of increased number of latent cancer fatalities.
[c] Based on a population of 745,287 persons residing within 80 kilometers (50 miles) of the site.

Consideration has also been given to the possibility of an accident at a collocated TA-V facility that could initiate an accident at the new SNL/NM facility. Because of the underground location of the new SNL/NM building and the distance to any nearby buildings, it was determined that there were no reasonably foreseeable collocated accidents. The new SNL/NM buildings would be located in the vicinity of the Albuquerque International Sunport aircraft runways. Small and large commercial aircraft and military aircraft use the runways. The annual probability of an aircraft crashing into a building located at TA-V has been estimated at 6.3×10^{-6} (DOE 1999f). Because the new facility building would be located underground, any aircraft crash into the building would not result in the release of nuclear materials (SNL/NM 2001a). Aboveground buildings would have either administrative functions or contain small amounts of radioactive materials, in which case the impacts of an aircraft crash would be bounded by the accidents analyzed in Tables 5–23 and 5–24.

The accident with the highest risk to the offsite population (see Table 5–24) would be a high-pressure spray fire on a Comet machine with a plutonium core accident. The increased number of latent cancer fatalities in the offsite population would be 2.2×10^{-7} per year (i.e., about 1 chance in 4 million per year of a latent cancer fatality). The highest risk of a latent cancer fatality to the maximally exposed offsite individual would be 1.7×10^{-11} per year (i.e., about 1 chance in 60 billion per year of a latent cancer fatality). The highest risk of a latent cancer fatality to a noninvolved worker located at a prescribed standoff distance of 100 meters (109 yards) from the accident would be 2.8×10^{-9} per year (i.e., about 1 chance in 300 million per year of a latent cancer fatality).

Hazardous Chemicals and Explosives Impacts—There would be no hazardous chemicals or explosives used or stored at the new or modified SNL/NM facilities, other than minor industrial quantities, that would impact workers or the public under accident conditions.

Involved Worker Impacts

Approximately 100 workers would be located at the new SNL/NM facility. During criticality experiments, workers would be safely located beyond a prescribed distance from the experiments.

Workers in the vicinity of an accident could be at risk of serious injury or fatality. The impacts from the uncontrolled reactivity insertion on the Comet or Planet assemblies with a plutonium core would be typical of worker impacts during accident conditions.

Facility operating procedures prohibit personnel from being in the test facility during remote operation of the Comet or Planet assemblies. If an accident occurs during a test run due to improper experiment setup and/or a combination of operator errors from the control room, the involved workers would be in the remote-control room and no workers would be present in the test facility. Workers in the remote-control room would be protected by a combination of shielding and distance from the immediate impacts of the accident. The remote-control room engineered safety features and/or protective actions taken by the control-room staff to limit contamination of the control-room environment would protect the involved workers.

In the event that workers in the bay area setting up the test initiate a criticality accident, it is anticipated these workers would be subject to serious injury or fatality as a result of the accident. Since the facility operating procedures would not prohibit workers from being in adjacent areas during operations, it is anticipated that workers in the vicinity outside of the bay would receive an estimated dose of less than 200 millirem after an uncontrolled criticality event. (This is estimated based on the potential energy released during this accident in relation to that used to design the shielding requirements.)

Following initiation of accident/site emergency alarms, workers would evacuate the area in accordance with site emergency operating procedures and would not be vulnerable to additional risk of radiological injury.

5.3.11 Environmental Justice

Construction Impacts—There would be no disproportionately high and adverse environmental impacts on minority and low-income populations due to construction under the SNL/NM Alternative. As stated in other subsections of Section 5.3, environmental impacts from construction would be small and would not expected be to extend beyond the SNL/NM site boundary.

Operational Impacts—No disproportionately high and adverse environmental impacts on minority and low-income populations would occur under the SNL/NM Alternative. This conclusion is a result of analyses presented in this EIS that determined there were no significant impacts on human health, ecological, cultural, paleontological, socioeconomic, and other resource areas described in other subsections of Section 5.3

During normal operations, approximately 10 curies of the noble gas argon-41 could be activated in the atmosphere. The impacts measured in terms of latent cancer fatalities on the general population would be small, as indicated in Table 5–22. Additionally, subsistence consumption of crops and wildlife radiologically contaminated with argon 41 would not be harmful since argon-41 has a half-life of 1 hour and 48 minutes and decays into a stable isotope of potassium that is not harmful to human health in small quantities.

Columns 2 and 3 of Table 5–24 show the radiological risks to the maximally exposed offsite individual and offsite population, respectively, that could result from postulated accidents under the SNL/NM Alternative. All of these risks are at least six orders of magnitude less than one latent cancer fatality. Hence, none of the postulated accidents would pose a significant radiological risk to the public, including minority and low-income individuals and groups within the population at risk.

5.3.12 Waste Management

In accordance with the Records of Decision for the *Waste Management PEIS* (DOE 1997a), waste could be treated and disposed of on site at SNL/NM or at other DOE sites or commercial facilities. Based on the Record of Decision for hazardous waste published on August 5, 1998 (63 FR 41810), nonwastewater hazardous waste will continue to be treated and disposed of at offsite commercial facilities. Based on the Record of Decision for low-level radioactive waste and mixed low-level radioactive waste published on February 18, 2000 (65 FR 10061), minimal treatment of low-level radioactive waste will be performed at all sites, and to the extent practicable, onsite disposal of low-level radioactive waste will continue. Hanford and NTS will be made available to all DOE sites for disposal of low-level radioactive waste. Mixed low-level radioactive waste analyzed in the *Waste Management PEIS* will be treated at Hanford, INEEL, the Oak Ridge Reservation, and the Savannah River Site and will be disposed of at Hanford and NTS.

It is assumed in this EIS that low-level radioactive waste, mixed low-level radioactive waste, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current and developing site practices. No high-level radioactive or transuranic waste is generated from the activities conducted for the TA-18 missions.

Construction Impacts—As previously discussed in Section 4.3.12.1 of this EIS, several environmental restoration sites are located at TA-V. If it is determined that any of these environmental restoration sites or any contaminated soils or other media requiring remediation extend into the construction area, further actions, including appropriate documentation, would be completed under the environmental restoration program. Therefore, potential waste generated from such remediation activities is not included in the *TA-18 Relocation EIS* analyses.

Only low-level radioactive and nonhazardous waste types are expected to be generated from the construction of the new underground facility building and modification of existing buildings at TA-V within SNL/NM. The impacts on the SNL/NM waste management systems, in terms of managing the waste, are discussed in this section. Radiological and chemical impacts on workers and the public from waste management activities are included in the public and occupational health and safety impacts provided in Section 5.3.10.

Low-level radioactive waste generated from construction activities would be sent to the Radioactive and Mixed Waste Management Facility in TA-III for processing to meet the waste acceptance criteria of DOE offsite disposal facilities. Approximately 170 cubic meters (220 cubic yards) of low-level radioactive waste would be generated from these construction activities (SNL/NM 2001a). This waste represents about 2.1 percent of the low-level radioactive waste storage capacity of the Radioactive and Mixed Waste Management Facility at TA-III—8,000 cubic meters (10,000 cubic yards). The impacts of managing this waste at SNL/NM would be minimal.

Solid nonhazardous waste generated from construction activities would be transferred to the Solid Waste Transfer Facility for screening to remove any potential hazardous waste and then sent to the Rio Rancho Sanitary Landfill in Rio Rancho, New Mexico, for disposal. Approximately 60 cubic meters (78 cubic yards) of solid nonhazardous waste would be generated from the construction activities (SNL/NM 2001a). The impacts of managing this waste at SNL/NM would be minimal.

Sanitary wastewater generated during construction activities would be managed using portable toilet systems.

Operations Impacts—The expected generation rates of waste at SNL/NM associated with relocating the TA-18 operations to a new location at SNL/NM are compared with SNL/NM's treatment, storage, and disposal capacities in **Table 5–25**. The impacts on the SNL/NM waste management systems, in terms of managing the waste, are discussed in this section. Radiological and chemical impacts on workers and the public from waste management activities are included in the public and occupational health and safety impacts provided in Section 5.3.10.

Table 5–25 Operations Waste Management Impacts under the SNL/NM Alternative

Waste Type [a]	*Estimated Waste Generation for TA-18 Mission Operations (cubic meters per year)*	*Estimated Waste Generation as a Percent of* [b]		
		Onsite Treatment Capacity	*Onsite Storage Capacity*	*Onsite Disposal Capacity*
Low-level radioactive waste				
Liquids	0	0	0	0
Solids	145	Not applicable	45	Not applicable
Mixed low-level radioactive waste				
Liquids	0	0	0	0
Solids	1.5	0.002	0.32	Not applicable
Hazardous waste				
Liquids	0	0	0	0
Solids	4 (4,000 kilograms per year)	Not applicable	Not applicable	Not applicable
Nonhazardous waste				
Sanitary wastewater	6,900 [c]	(d)	Not applicable	(d)
Solids	0	0	0	0

[a] See definitions in Chapter 8.
[b] The estimated amounts of waste generated annually are compared with the annual site treatment capacities. The estimated total amounts of waste generated over the assumed 25-year operating period are compared with the site storage and disposal capacities.
[c] Based on the assumption of 100 workers generating 50 gallons per day.
[d] This sanitary wastewater would be sent to the Albuquerque sanitary sewer system.
Note: To convert from cubic meters per year to cubic yards per year, multiply by 1.308; to convert from kilograms to pounds, multiply by 2.2.
Not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on site, or is not held in long-term storage).

Solid low-level radioactive waste generated from TA-18 activities conducted at the new location in SNL/NM would be sent to the Radioactive and Mixed Waste Management Facility at TA-III for processing to meet the waste acceptance criteria of DOE offsite disposal facilities. Approximately 3,600 cubic meters (4,700 cubic yards) of low-level radioactive waste would be generated from these operations activities over the 25-year operating period. This total waste represents about 45 percent of the low-level radioactive waste storage capacity of the Radioactive and Mixed Waste Management Facility at TA-III — 8,000 cubic meters (10,000 cubic yards). However, because low-level radioactive waste generated by SNL/NM is generally transported off site to appropriate DOE-approved disposal facilities, such as NTS (DOE 1999f), this waste is not expected to be managed in long-term storage. The impacts of managing this waste at SNL/NM would be minimal.

Mixed low-level radioactive waste generated from TA-18 activities conducted at a new location in SNL/NM would be treated, if possible, at the Radioactive and Mixed Waste Management Facility and the High-Bay Mixed Waste Storage Facility, and the treatment residues would be shipped to a commercial or DOE disposal facility. Waste that cannot be treated on site would be shipped off site to a commercial or DOE treatment and disposal facility. The mixed low-level radioactive waste generated from TA-18 activities would be managed in accordance with the SNL/NM site treatment plan. About 38 cubic meters (50 cubic yards) of mixed low-level radioactive waste would be generated over the 25-year operating period of conducting TA-18 activities at SNL/NM. This waste represents about 0.32 percent of the mixed low-level waste storage capacity at SNL/NM—11,866 cubic meters (15,520 cubic yards)—and about 0.002 percent of the mixed low-level radioactive waste annual treatment capacity at SNL/NM—61,326 cubic meters (80,214 cubic yards) per year. The impacts of managing this waste at SNL/NM would be minimal.

Hazardous waste generated from TA-18 activities conducted at a new location in SNL/NM would be sent to the Hazardous Waste Management Facility, located at TA-II, for packaging and short-term (less than one year) storage. This waste would then be shipped off site to RCRA-permitted commercial facilities for recycling, treatment, and disposal. The annual estimate of 4,000 kilograms (8,800 pounds) per year represents about 2.5 percent of the annual hazardous waste generation rate—158,965 kilograms (350,000 pounds) per year for the entire SNL/NM site. The impacts of managing this waste at SNL/NM would be minimal.

Sanitary wastewater generated as a result of TA-18 activities conducted at a new location in SNL/NM would be sent to the Albuquerque sanitary sewer system. Approximately 6,900 cubic meters (9,000 cubic yards) per year of sanitary wastewater would be generated from relocating TA-18 missions to SNL/NM. The impacts of managing this waste would be minimal.

5.3.13 Transportation Impacts

The transportation impact analysis was carried out as described in Appendix D. Under the SNL/NM Alternative, approximately 92 shipments of radioactive materials from TA-18 would be relocated to SNL/NM. The total distance traveled on public roads by trucks carrying radioactive materials would be 31,000 kilometers (19,000 miles).

Incident-Free Transportation Impacts—The dose to transportation workers from all transportation activities under this alternative was calculated at 0.025 person-rem; the dose to site workers involved in packaging and loading at TA-18 and unloading and unpacking at SNL/NM was calculated at 2.3 person-rem; and the dose to the public was calculated at 0.0009 person-rem. Accordingly, incident-free transportation of radioactive material would result in 0.000010 latent cancer fatalities among transportation workers; 0.004 latent cancer fatalities among site workers; and 0.000020 latent cancer fatalities in the total affected population over the duration of the transportation activities. The number of nonradiological fatalities from vehicular emissions associated with this alternative was calculated to be 0.00020.

Transportation Accidents Impacts—Estimates of total transportation accident risks under the SNL/NM Alternative are as follows: a collective dose to the affected population of 7.0×10^{-6} person-rem, resulting in 3.5×10^{-9} latent cancer fatalities; a traffic accident, resulting in 8.5×10^{-6} traffic fatalities; and a dose of 139 rem to a hypothetical maximally exposed individual located 33 meters (108 feet) directly downwind from a most severe accident (severity category 8) with a release frequency of 5×10^{-8} per year, leading to a risk of 0.07 of developing a latent cancer fatality.

5.3.14 Cumulative Impacts

The projected incremental environmental impacts of implementing the proposed action at SNL/NM were added to the environmental impacts of other present and reasonably foreseeable actions at or near SNL/NM to obtain cumulative site impacts under normal operations. The cumulative impact analysis presented in Chapter 6 of the *SNL/NM SWEIS* (DOE 1999f) discusses the separate contributory effects from seven other DOE facilities, the U.S. Department of Defense (DOD) activities at KAFB, and activities in the region surrounding SNL/NM, including the contributory effects of the Cobisa Power Station. The seven additional DOE facilities are the DOE Albuquerque Operations Office; Energy Training Complex; Transportation Safeguards Division; Nonproliferation and National Security Institute; Ross Aviation, Inc.; Lovelace Respiratory Research Institute; and Federal Manufacturing & Technology/New Mexico (also known as AlliedSignal). For more detailed descriptions and discussions of the contributory effects from ongoing actions at SNL/NM, KAFB, and the region surrounding SNL/NM, refer to Chapter 6 of the *SNL/NM SWEIS*. Impacts from these and other ongoing actions at SNL/NM have been included in the affected environment baseline conditions described for SNL/NM and presented in Chapter 4, Section 4.3.

Impacts from other reasonably foreseeable future actions at SNL/NM include those presented in the *SNL/NM SWEIS* and the *Environmental Assessment for the Microsystems and Engineering Sciences Applications Complex* (DOE 2000g), which are described along with other relevant NEPA reviews in Sections 1.4.1.8 and 1.4.1.12, respectively. The proposed action for the Microsystems and Engineering Sciences Applications Complex involves renovation of and upgrades to the Microelectronics Development Laboratory; construction of three new facilities; relocation of the activities currently conducted at the Compound Semiconductor Research Laboratory and several other buildings to new facilities; and demolition of the Compound Semiconductor Research Laboratory building. Impacts from this action were factored into estimates of total cumulative impacts, where possible, for the potentially affected resource areas presented in this section. Another reasonably foreseeable action involves the proposed Sandia Underground Reactor Facility, for which an environmental assessment is expected to be completed in late 2001. Specific information about potential environmental impacts associated with this action is not available and cannot be factored into this cumulative impact analysis.

Cumulative transportation impacts were determined by analyzing the impacts along the various routes used to transport the materials associated with relocated TA-18 activities over the 25-year operating period. The methodology for assessing cumulative impacts is presented in Appendix F.

In this section, cumulative site impacts are presented only for those "resources" at a site that reasonably may be expected to be affected by the proposed action. These include site employment, electrical consumption, water usage, air quality, waste management, and public and occupational health and safety. This section also includes the cumulative impacts associated with intersite transportation.

Resource Requirement Impacts—Cumulative impacts on key resource requirements at SNL/NM would be small. Use of all major resources would remain within the SNL/NM site capacity. The proposed relocation of TA-18 operational capabilities and materials would require an increase in the site's use of electricity and water of approximately 2 percent and 0.1 percent, respectively. Cumulatively with the addition of the TA-18 operations and the proposed action for the Microsystems and Engineering Sciences Application Complex, SNL/NM would use about 48 percent of the available electrical capacity and 58 percent of the available water capacity. Site employment could increase by approximately 20 workers.

Air Quality Impacts—The *SNL/NM SWEIS* considered the incremental effects of ongoing and reasonably foreseeable future actions at SNL/NM, KAFB, and the Cobisa Power Station in evaluating cumulative impacts at SNL/NM. Background ambient air pollutant concentrations previously described in Chapter 4 of this EIS include impacts from KAFB and the Cobisa Power Station. Reasonably foreseeable future actions at SNL/NM and KAFB through 2008, evaluated in the *SNL/NM SWEIS* cumulative impacts section, would result in an increase in one-hour carbon monoxide concentrations of about 398 micrograms per cubic meter and an increase in three-hour sulfur dioxide concentrations of about 28 micrograms per cubic meter. Conversely, changes in these activities are projected to result in some decrease in air pollutant concentrations for other averaging periods for carbon monoxide, sulfur dioxide, and other criteria pollutants. In addition, the increase in SNL/NM and KAFB commuter traffic is expected to result in a 13.3 percent increase in carbon monoxide emissions from highway sources within Bernalillo County in 2005. Although there have been small changes in monitored concentrations for certain pollutants from the 1996 data used in the *SNL/NM SWEIS* cumulative impacts analysis, the conclusion of that analysis remains unchanged. The contributions from TA-18 operations and the proposed action for the Microsystems and Engineering Sciences Application Complex to overall site concentrations are expected to be small. SNL/NM is currently in compliance with all Federal and state ambient air quality standards and would continue to remain in compliance, even after including the cumulative effects of all reasonably foreseeable activities.

Public and Occupational Health and Safety – Normal Operations Impacts—Cumulative impacts in terms of radiation exposure to the public and workers at SNL/NM were considered for present and reasonably foreseeable activities. The impact from the proposed action for the Microsystems and Engineering Sciences Application Complex has been determined to be minimal (DOE 2000g). With the addition of the impacts from relocated TA-18 operational capabilities and materials at SNL/NM, the cumulative impacts would still be negligible. There would be no increase expected in the number of latent cancer fatalities in the population from site operations if TA-18 security Category I/II operations were to be relocated to SNL/NM. The dose limits for individual members of the public are given in DOE Order 5400.5. As discussed in that order, the dose limit from airborne emissions is 10 millirem per year, as required by the Clean Air Act; the dose limit from drinking water is 4 millirem per year, as required by the Safe Drinking Water Act; and the dose limit from all pathways combined is 100 millirem per year. Therefore, the dose to the maximally exposed offsite individual would be expected to remain well within regulatory limits. Onsite workers would be expected to have an increase of approximately 0.004 latent cancer fatalities due to radiation from TA-18 operations over the 25-year operating period.

Waste Management Impacts—As presented in Section 5.3.12, relocation of TA-18 operational capabilities and materials at SNL/NM would not generate more than a small amount of additional waste at the site. Similarly, impacts associated with the proposed action for the Microsystems and Engineering Sciences Application Complex are also projected to be small (DOE 2000g), and the cumulative impacts of these actions at SNL/NM are expected to be minimal. It is unlikely that there would be major impacts on waste management at SNL/NM because sufficient capacity would exist to manage the site waste.

Transportation Impacts—The cumulative impacts from transportation associated with the relocation of TA-18 operational capabilities and materials are identified in Appendix D. Because likely transportation routes cross many states, cumulative impacts are compared on a national basis. Under the SNL/NM Alternative assessed in this *TA-18 Relocation EIS*, occupational radiation exposure to transportation workers and exposure to the public are estimated to represent less than 0.01 percent of the cumulative exposures from nationwide transportation (DOE 1999d). No additional traffic fatality is expected; the incremental increase in traffic fatalities would be less than 0.0001 percent per year.

5.4 NTS ALTERNATIVE

Section 5.4 discusses the environmental impacts associated with the relocation of the TA-18 operational capabilities and materials to NTS. As discussed in Section 3.3.5, the relocation involves only security Category I/II activities. The environmental impacts associated with the relocation of SHEBA and other security Category III/IV activities are discussed separately in Section 5.6.

Under the NTS Alternative, the TA-18 security Category I/II activities would be relocated to the existing Device Assembly Facility (DAF) at NTS Area 6, which would be modified internally to accommodate the activities. The alternative also involves the construction of new buildings at NTS to support the security Category I/II activities (see Section 3.3.5). The Expanded Use Alternative presented in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (NTS SWEIS)* (DOE 1996e) provides the baseline from which incremental effects of the proposed action at NTS are measured.

5.4.1 Land Resources

5.4.1.1 Land Use

Construction Impacts—Under this alternative, a new Low-Scatter Building would be built on 0.6 hectares (1.4 acres) of undisturbed land located just to the west of the DAF complex. A roadway and utility access to this new facility would be another 0.2 hectares (0.5 acres) of land. A new Administration Building would also be built under this alternative. It would occupy 0.1 hectares (0.3 acres) of previously disturbed land adjacent to DAF. Both new structures would be within a portion of NTS that has a Defense Industrial Zone land-use designation (see Section 4.4.1.1). In addition to new construction, internal modifications also would be made to DAF. Both the new construction and modifications to DAF would be compatible with the area's current land use and with its present land-use designation.

Operations Impacts—Operations of new facilities and DAF for relocated TA-18 operations would be compatible with the current land-use designation of the area. Thus, there would be no impact on land use during the operational phase of the proposed action.

5.4.1.2 Visual Resources

Construction Impacts—Activities related to the construction of a new Low-Scatter Building and Administration Building would result in a change to the visual appearance of the DAF area due to the presence of construction equipment and possibly increased dust. These changes would be temporary and, due to the isolated location of the area, would not be visible from areas beyond NTS. Modifications to DAF required to support TA-18 operations would be internal and, thus, would not result in any change to the visual appearance of the facility during construction.

Operations Impacts—The new Low-Scatter and Administration Buildings would represent a change in the appearance of the DAF area. However, these changes would be consistent with current development in the area and, as noted above, would not be visible by the public from any location beyond the NTS boundary. Modifications to DAF would not result in any change to the appearance of the structure. Thus, the current Class IV Bureau of Land Management Visual Resource Management rating of the area would not change as a result of the proposed action.

5.4.2 Site Infrastructure

Construction Impacts—The projected demands on key site infrastructure resources associated with site construction under this alternative on an annualized basis are presented in **Table 5–26**. Existing NTS infrastructure would easily be capable of supporting the requirements associated with DAF modifications and construction of new support buildings at NTS Area 6 proposed under this alternative without exceeding site capacities. Although gasoline and diesel fuel would be required to operate construction vehicles, generators, and other construction equipment, fuel would be procured from either current DAF inventories or possibly offsite sources and, therefore, would not be a limited resource. Nevertheless, fuel usage during construction is not expected to exceed current DAF usage. Impacts on the local transportation network are expected to be negligible.

Operations Impacts—Resources needed to support operations under the NTS Alternative are presented in **Table 5–27**. It is projected that existing NTS and DAF infrastructure resources would be adequate to support proposed mission activities over 25 years.

Table 5–26 Annual Site Infrastructure Requirements for Facility Construction under the NTS Alternative

Resource	Available Site Capacity [a]	NTS Alternative [b]	
		Requirement	Percent of Available Site Capacity
Electricity			
Energy (megawatt-hours per year)	75,467	16	0.02
Peak load (megawatts)	18	0.012	0.07
Fuel			
Natural gas (cubic meters per year)	Not applicable	0	Not applicable
Gasoline and diesel fuel (liters per year) [c]	Not limited	Negligible	Not limited
Water (liters per year)	4,318,000,000	3,975,000	0.09

[a] Capacity minus the current site requirements, a calculation based on the data provided in Table 4–36, *TA-18 Relocation EIS*.
[b] Represents total rather than annualized values, as the projected period of construction is only nine months.
[c] Not limited due to offsite procurement.
Sources: Table 4–36, *TA-18 Relocation EIS*; NTS 2001.

Table 5–27 Annual Site Infrastructure Requirements for Facility Operations under the NTS Alternative

Resource	Available Site Capacity [a]	NTS Alternative [b]	
		Requirement	Percent of Available Site Capacity
Electricity			
Energy (megawatt-hours per year)	75,467	146	0.2
Peak load (megawatts)	18	0.08	0.4
Fuel			
Natural gas (cubic meters per year)	Not applicable	0	Not applicable
Liquid fuels (liters per year) [c]	Not limited	Negligible	Not limited
Coal (metric tons per year)	Not applicable	0	Not applicable
Water (liters per year)	4,318,000,000	6,900,000	0.2

[a] Capacity minus the current site requirements, a calculation based on the data provided in Table 4–36, *TA-18 Relocation EIS*.
[b] Reflects additional demand within Area 6 in excess of current DAF requirements.
[c] Not limited due to offsite procurement.
Sources: Table 4–36, *TA-18 Relocation EIS*; NTS 2001.

5.4.3 Air Quality

5.4.3.1 Nonradiological Releases

Construction Impacts—Construction of new buildings and modification of the existing DAF at NTS Area 6 would result in an increase in air quality impacts from construction equipment, trucks, and employee vehicles. Criteria pollutant concentrations for construction were modeled and compared to the most stringent standards (see **Table 5–28**). The maximum ground-level concentrations that would result from construction would be well below the ambient air quality standards. The maximum concentrations would occur at the site boundary along U.S. Route 95 south of DAF for short-term concentrations and east-southeast of DAF for annual concentrations. Modeling of construction air quality considered particulate emissions from activity in a construction area of 2.8 hectares (7 acres) for security Category I/II activities and emissions from various earthmoving and materials-handling equipment. For the purpose of analysis, construction equipment emissions at NTS were assumed to be similar to the site work and new construction emissions at LANL (TA-18) for the TA-18 Upgrade Alternative.

Table 5–28 Nonradiological Air Quality Concentrations at the Site Boundary under the NTS Alternative – Construction

	Averaging Period	*Most Stringent Standard or Guideline (micrograms per cubic meter)* [a]	*Maximum Incremental Concentration (micrograms per cubic meter)* [b]
Carbon monoxide	8 Hours 1 Hour	10,000 40,000	2.52 20.1
Nitrogen dioxide	Annual	100	0.004
PM_{10}	Annual 24 Hours	50 150	0.021 3.44
Sulfur dioxide	Annual 24 Hours 3 Hours	80 365 1,300	less than 0.001 0.076 0.605

PM_{10} = particulate matter less than or equal to 10 microns in diameter.

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean PM_{10} standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] The concentrations were analyzed at locations to which the public has access—the site boundary and nearby sensitive areas.

Sources: 40 CFR 50, NTS 2001.

Operations Impacts—Under the NTS Alternative, criteria and toxic air pollutants would be generated from the operation of the emergency diesel generators and other activities at NTS Area 6. The emissions are generated from diesel generators currently in operation and would be considered as part of the baseline concentrations (see Section 4.4.3.1). No increases in emissions or air pollutant concentrations are expected under this alternative. Therefore, a Prevention of Significant Deterioration increment analysis is not required (see Appendix F, Section F.3.1). In addition, NTS is located in an attainment area for criteria air pollutants; therefore, no conformity analysis is required (see Appendix F, Section F.3.2).

5.4.3.2 Radiological Releases

Construction Impacts—While no radiological releases to the environment are expected in association with construction activities at DAF, the potential exists for contaminated soils and possibly other media to be disturbed during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any contamination and would be required to remediate any contamination in accordance with procedures established under NTS's environmental restoration program.

Operations Impacts—Approximately 10 curies per year of argon-41 would be released from the relocated TA-18 operations at the NTS DAF (see Section 3.2.1). There would be no other radiological releases from the relocated mission activities. Impacts from radiological releases are described in Section 5.4.10.1.

5.4.4 Noise

Construction Impacts—Construction of new facilities and modification of DAF at NTS Area 6 would result in some temporary increase in noise levels near the area from construction equipment and activities. Some disturbance of wildlife near the area may occur as a result of operation of construction equipment. There would be no change in noise impacts on the public as a result of construction activities, except for a small increase in traffic noise levels from construction employees and material shipments along routes leading to NTS. Noise sources associated with construction at NTS Area 6 are not expected to include loud impulsive sources such as blasting.

Operations Impacts—Noise impacts from operations of the new buildings at NTS Area 6 are expected to be similar to those from existing operations at Area 6. Although there would be a small increase in traffic and equipment noise (e.g., heating and cooling systems, generators, etc.) near the area, there would be little change in noise impacts on wildlife and little increase in noise impacts on the public outside of NTS as a result of moving security Category I/II activities to NTS.

5.4.5 Geology and Soils

Construction Impacts—Construction under this alternative is expected to disturb a total of 0.9 hectares (2.2 acres) of land. Although some aggregate and other geologic resources (e.g., sand) likely would be required to support construction activities in Area 6, these resources are abundant throughout NTS and surrounding areas. Because blasting should not be necessary, as the area is underlain by alluvium, and the land area to be disturbed is relatively small, the impact on geologic and soil resources would be relatively minor overall. A site survey and foundation study would be conducted as necessary to confirm site geologic characteristics for facility engineering purposes. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any contaminated media and remediation required in accordance with procedures established under the site's environmental restoration program.

As discussed in Section 4.4.5, NTS is located in a region with relatively high seismicity. Ground shaking of Modified Mercalli Intensity VII (see Appendix F, Table F–6) associated with postulated earthquakes is possible and supported by the historical record for the region. Further, minor to moderate earthquakes have been epicentered within the site within the last decade. Modified Mercalli Intensity VII ground shaking would be expected to affect primarily the integrity of inadequately designed or nonreinforced structures, but damage to properly or specially designed or upgraded facilities would not be expected. Nevertheless, three potentially active fault systems intersect the site and, thus, should be considered capable. The closest capable fault (Cane Spring) is located about 5 kilometers (3 miles) southeast of DAF. The potential for other large-scale geologic hazards to affect Area 6 facilities is generally low.

As stated in DOE Order 420.1, DOE is required to ensure that nuclear and nonnuclear facilities be designed, constructed, and operated so that workers, the public, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes.

Operations Impacts—The operations of new and modified buildings under this alternative would not be expected to result in impacts on geologic and soil resources at NTS. As discussed above, the proposed new support buildings and modifications to DAF would be evaluated, designed, and constructed in accordance with DOE Order 420.1 and sited to minimize the risk from geologic hazards. Thus, site geologic conditions would not likely affect the facilities.

5.4.6 Water Resources

5.4.6.1 Surface Water

Construction Impacts—Surface water would not be used to support the construction of new buildings or modifications of DAF at NTS Area 6. Groundwater is the source of water at NTS. There are no natural surface water bodies in the vicinity of DAF that are a viable source of water. Therefore, there would be no construction impact on surface water availability. Sanitary wastewater would be generated by construction personnel. As plans include the use of portable toilets, there would be no onsite discharge of sanitary wastewater and no impact on surface waters. Waste generation and management activities are detailed in Section 5.4.12.

The potential for storm-water runoff from construction areas to impact downstream surface water quality is small. Although runoff from the vicinity of the site drains toward Frenchman Lake, which has standing water during the winter months, surface drainages in the vicinity of DAF and on the site in general are ephemeral, and runoff infiltration is rapid on alluvium. In addition, Frenchman Lake is located some 16 kilometers (10 miles) southeast of the site. Therefore, any effects on runoff quality would likely be very localized and of short duration. Appropriate soil erosion and sediment control measures (e.g., sediment fences, stacked haybales, mulching disturbed areas, etc.) and spill prevention practices would be employed during construction to minimize suspended sediment and material transport and potential water quality impacts. No floodplains have been mapped for DAF and the vicinity. Nevertheless, the current DAF is protected from flooding posed by sheet-flow runoff from heavy precipitation events and/or rising playa water levels by a storm-water conveyance and diversion structure. Similar safeguards would be constructed as necessary for the proposed new DAF support buildings and would be sited in accordance with applicable regulatory requirements and DOE orders (e.g., DOE Order 420.1), including Executive Order 11988, *Floodplain Management*.

Operations Impacts—No impacts on surface water resources are expected as a result of operations at DAF. No surface water would be used to support facility activities, and there would be no discharge of sanitary or industrial effluent to surface waters. Sanitary wastewater would be generated as a result of operations stemming from staff use of lavatory, shower, and break-room facilities and from miscellaneous potable and sanitary uses. Nevertheless, it is planned that this wastewater would be collected and conveyed to existing wastewater treatment facilities. In addition, no industrial or other NPDES-regulated discharges to surface waters are anticipated. Waste generation and management activities are detailed in Section 5.4.12. Overall, operational impacts on site surface waters and downstream water quality would be expected to be negligible.

5.4.6.2 Groundwater

Construction Impacts—Water would be required during construction for such uses as dust control and soil compaction, washing and flushing activities, and to meet the potable and sanitary needs of construction employees. Water use by construction personnel would be greatly reduced over that normally required by the proposed use of portable toilets. In addition, concrete and the water required for concrete mixing would likely be procured off site. As a result, it is estimated that construction activities would require approximately 4 million liters (1.06 million gallons) of groundwater on an annualized basis (see Table 5–26), mainly to support new facility construction and renovations to existing facilities. It is currently anticipated that this water would be derived from the Area 6 groundwater distribution system serving DAF via a temporary service connection or trucked to the point of use, especially during the early stages of construction.

The relatively small volume of groundwater required during the period of construction compared to site availability and historic usage indicates that construction withdrawals should not have an additional impact on regional groundwater levels or availability. As the depth of groundwater is generally greater than 280 meters (920 feet), construction dewatering would not be required.

There would be no onsite discharge of wastewater to the surface or subsurface, and appropriate spill prevention controls, countermeasures, and procedures would be employed to minimize the chance for petroleum, oils, lubricants, and other materials used during construction to be released to the surface or subsurface and to ensure that waste materials are properly disposed of. Waste generation and management activities are detailed in Section 5.4.12. In general, no impact on groundwater availability or quality is anticipated.

Operations Impacts—Activities at DAF under the NTS Alternative would use groundwater primarily to meet the potable and sanitary needs of facility support personnel, as well as for miscellaneous building mechanical uses. It is estimated that about 6.9 million liters (1.8 million gallons) of water would be required annually for facility operations. As this demand would be a small fraction of existing NTS usage and would not exceed site availability (see Table 5–27), no additional measurable impact on regional groundwater levels or availability would be anticipated.

No sanitary or industrial effluent would be directly discharged to the surface or subsurface. Waste generation and management activities are detailed in Section 5.4.12. Thus, no operational impacts on groundwater quality would be expected.

5.4.7 Ecological Resources

5.4.7.1 Terrestrial Resources

Construction Impacts—Under this alternative, a new Low-Scatter Building (including a new roadway and utility access) would be built on 0.8 hectares (1.9 acres) of undisturbed land located just to the west of the DAF complex. A new Administration Building would also be built under this alternative. It would occupy 0.1 hectare (0.3 acres) of previously disturbed land adjacent to DAF. Construction of the Low-Scatter Building would result in the loss of native creosote bush habitat, while construction of the Administration Building would not disrupt natural habitat. The loss of 0.8 hectares (1.9 acres) of creosote bush habitat would represent a very small percentage of this type of habitat, both within the immediate vicinity of DAF and on NTS as a whole (see Section 4.4.7.1).

Wildlife presently using areas proposed for TA-18 operations would be lost or displaced by construction. The loss of creosote bush habitat resulting from construction of the Low-Scatter Building would have minimal effect on wildlife found in the vicinity of DAF, due to the extensive amount of this type of habitat found in the general area and NTS as a whole. Loss and displacement of wildlife resulting from construction of the Administration Building would be expected to be limited due to the developed nature of the site. Noise could cause temporary disruption to wildlife found in areas adjacent to the construction sites; however, these impacts would be temporary. Since all activities would take place within a defined construction zone, direct human disturbance to wildlife and wildlife habitat outside of that zone, such as might be caused by the movement of equipment, would not occur.

Operations Impacts—Operations of facilities associated with relocated TA-18 operations would not adversely impact either wildlife or wildlife habitat at the DAF site because relocated TA-18 operations would not produce emissions at levels that would affect wildlife. The sewage evaporation ponds would receive increased flows as a result of the operations of relocated TA-18 mission support facilities, thus ensuring a continued water supply for wildlife that use the ponds.

5.4.7.2 Wetlands

Construction and Operations Impacts—There are no wetlands located within or adjacent to the areas of NTS which would be disturbed by the newly constructed buildings; therefore, this resource would not be affected during either construction or operations. For the same reason, modifications to DAF required to support TA-18 operations also would not have an impact on wetlands.

5.4.7.3 Aquatic Resources

Construction and Operations Impacts—There are no natural aquatic resources located within or adjacent to the areas of NTS which would be disturbed by the newly constructed buildings; therefore, this resource would not be affected during either construction or operations. For the same reason, modifications to DAF required to support TA-18 operations also would not have an impact on aquatic resources.

5.4.7.4 Threatened and Endangered Species

Construction and Operations Impacts—Under this alternative, construction of new facilities at NTS may impact the federally threatened desert tortoise. Area 6 is located at the northern end of the Mojave Desert tortoise range. Prior to disturbance of land, a preactivity survey would have to be conducted for desert tortoises and their burrows. In addition, transportation during construction might have an impact on desert tortoises because of the increased risk of crushing individual tortoises along the road. However, due to the low population density of the desert tortoise at NTS, it is doubtful that this impact would exceed the allowable losses due to inadvertent taking pursuant to the Biological Opinion for NTS. No other impacts on threatened and endangered species would result from implementation of this alternative. Operations would not impact threatened and endangered species because relocated TA-18 operations would not produce emissions or effluent of quality or at levels that would likely affect these species.

5.4.8 Cultural and Paleontological Resources

5.4.8.1 Prehistoric Resources

Construction and Operations Impacts—The site proposed for constructing the new Administration Building was previously disturbed by construction of the DAF. As such, the likelihood of locating prehistoric resources would be slight. However, the site of the Low-Scatter Building has not been previously disturbed, and the possibility exists that prehistoric resources could be disturbed during construction. A cultural resource survey would be conducted prior to construction. If prehistoric resources were discovered during construction, all work potentially affecting the resources would stop. This work stoppage would be followed by investigations by qualified cultural resource specialists, any coordination necessary with the State Historic Preservation Office, and development and implementation of measures to salvage these resources. The relocation of TA-18 operational capabilities and materials would not affect prehistoric resources under this alternative.

5.4.8.2 Historic Resources

No historic resources have been identified in the immediate vicinity of DAF, although four historic sites have been identified in the Frenchman Flat area (see Section 4.4.8.2). Thus, impacts on historic resources are unlikely to result from the construction of new facilities at the DAF site. A cultural resource survey would be conducted prior to the beginning of construction. The relocation of TA-18 operational capabilities and materials would not affect historic resources under this alternative.

5.4.8.3 Native American Resources

While no prehistoric or historic Native American resources have been located at the DAF site, the Consolidated Group of Tribes and Organizations has identified a number of plant and animal species present within Area 6 that are of cultural importance to Native Americans. Potential impacts on these resources would be expected to be minimal since, as noted in Section 5.4.7.1, impacts on ecological resources resulting from construction and operations of facilities associated with relocated TA-18 operations would be minimal. As noted in Section 5.4.8.1, if any prehistoric Native American resources were located during construction, work would stop while appropriate action was taken. The relocation of TA-18 operational capabilities and materials would not affect Native American resources under this alternative.

5.4.8.4 Paleontological Resources

Construction and Operations Impacts—Construction and operations of relocated TA-18 mission facilities within the DAF area are unlikely to impact paleontological resources, since no such sites have been identified on NTS. Also, fossils were not found during construction of DAF. Nevertheless, paleontological resources would be included in the scope of the cultural resource survey that would be conducted prior to the beginning of construction.

5.4.9 Socioeconomics

Construction Impacts—Modifications to DAF facilities and construction of new buildings would require a peak construction employment level of 60 workers. This level of employment would generate about 114 indirect jobs in the region around NTS. The potential total employment increase of 174 direct and indirect jobs represents an approximate 0.03 percent increase in the workforce and would occur only over the nine months of construction. It would have no noticeable impact on the socioeconomic conditions of the region of influence.

Operations Impacts—Relocation of TA-18 operational capabilities and materials associated with security Category I/II activities to DAF could result in the permanent relocation or hiring of approximately 20 new employees and a small reduction in employment levels at LANL. This level of employment would generate about 38 indirect jobs in the region around NTS. The potential total employment increase of 58 direct and indirect jobs represents an approximate 0.01 percent increase in the workforce. It would have no noticeable impact on the socioeconomic conditions of the region of influence.

5.4.10 Public and Occupational Health and Safety

The assessments of potential radiological impacts associated with the NTS Alternative are presented in this section. No chemical-related health impacts are associated with any of these alternatives because only very small quantities of industrial-type chemicals, such as ethanol, isopropyl alcohol, magnesium oxide, phenylphosphine, and xylene, would be used. As stated in the *LANL SWEIS* (DOE 1999b), the quantities of these chemicals that could be released to the atmosphere during normal operations are minor and would be below screening levels used to determine the need for additional analysis. There would be no operational increase in the use of these chemicals as a result of the proposed action. No chemicals have been identified that would be a risk to members of the public from construction activities associated with the NTS Alternative. Construction workers would be protected from hazardous chemicals by adherence to OSHA and EPA occupational standards that limit concentrations of potentially hazardous chemicals. The potential occupational (industrial) impacts on workers during construction and operations were evaluated based on DOE and Bureau of Labor statistic data, and are detailed in Section C.7 of Appendix C. Construction and operations activities under this alternative are expected to result in some injuries but no fatalities to workers for the duration of the proposed action (i.e., about 3 years of construction and 25 years of operations).

Summaries of radiological impacts from normal operations and postulated accidents are presented below. The methodologies used to determine the impacts on the public and on facility workers are presented in Appendix B. Supplemental information associated with normal operations and postulated accidents is provided in Appendices B and C, respectively.

5.4.10.1 Construction and Normal Operations

Construction Impacts—No radiological risks would be incurred by members of the public from construction activities. Construction workers may be at a small risk. They could receive doses above natural background radiation levels from exposure to radiation from other past or present activities at the site. However, these workers would be protected through appropriate training, monitoring, and management controls. Their exposures would be limited to ensure that doses were kept as low as is reasonably achievable.

Operations Impacts—Under this alternative, the only radiological release would be 10 curies per year of argon-41 to the atmosphere from Godiva operations (see Section 5.4.3.2). The associated calculated impacts on the public are presented in **Table 5–29**. The only dose pathway for receptors would be from immersion in the passing plume. To put the doses into perspective, comparisons with natural background radiation levels are included in the table.

Table 5–29 Annual Radiological Impacts on the Public from TA-18 Operations at NTS

Receptor	*Impact Values*
Population within 80 Kilometers (50 Miles)	
Collective dose (person-rem)	7.0×10^{-5}
Percent of natural background radiation [a]	1.2×10^{-6}
Cancer fatalities [b]	3.5×10^{-8}
Maximally Exposed Offsite Individual	
Dose (millirem)	8.7×10^{-5}
Percent of regulatory dose limit [c]	8.7×10^{-4}
Percent of natural background radiation [a]	2.7×10^{-5}
Cancer fatalities risk [b]	4.4×10^{-11}
Average Individual within 80 Kilometers (50 Miles)	
Dose (millirem)	3.9×10^{-6}
Percent of natural background radiation [a]	1.2×10^{-6}
Cancer fatalities risk [b]	1.9×10^{-12}

[a] The average annual dose from background radiation at NTS is 314 millirem (see Section 4.4.11.1); the 18,100 people living within 80 kilometers (50 miles) would receive an annual dose of 5,670 person-rem from the background radiation.
[b] Based on a cancer risk estimate of 0.0005 latent cancer fatalities per person-rem (see Appendix B).
[c] This comparison cannot be made for the population and average individual because there is no standard or limit.

As shown in the table, the expected annual radiation dose to the maximally exposed offsite individual member of the public would be much smaller than the limit of 10 millirem per year set by both the EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The risk of a cancer fatality to this individual from annual operations would be approximately 4.4×10^{-11} per year (i.e., about 1 chance in 15 billion per year of a latent cancer fatality). The projected number of fatal cancers to the population within 80 kilometers (50 miles) would be 3.5×10^{-8} per year (i.e., about 1 chance in 23 million per year of a latent cancer fatality).

Annual radiological doses to the 100 workers involved with operations of the relocated TA-18 mission facilities under this alternative would average 100 millirem per worker, for a total workforce annual dose of 10 person-rem. The annual doses to individual workers would be well below the DOE limit of 5,000 millirem (10 CFR 835); the DOE Control Level of 1,000 millirem per year, as established in 10 CFR 835.1002; and the recommended Administrative Control Level of 500 millirem (DOE 1999e). An individual worker's annual risk of a fatal cancer is projected to be 4.0×10^{-5} (i.e., about 1 chance in 25,000 per year of a latent cancer fatality), and the projected number of fatal cancers in the workforce from operations would be 0.0040 per year (or 1 chance in 250 that the workers would experience a fatal cancer per year of operations).

5.4.10.2 Facility Accidents

Under the NTS Alternative, TA-18 operational capabilities and materials would be relocated to DAF. DAF would include safety features that would reduce the risks of accidents that currently exist at LANL under the No Action Alternative. The accident scenarios described for the No Action Alternative at LANL are considered applicable to DAF, with one exception. Accidents associated with SHEBA are excluded because the SHEBA missions would be moved to LANL's TA-39; its impacts are shown in Section 5.6.3.10. Certain scenario parameter values applicable to the No Action Alternative, such as leak path factors, materials at risk, and the corresponding source term, have been adjusted to reflect improved safety features of DAF.

Radiological Impacts—**Table 5–30** shows the frequencies and consequences of the postulated set of accidents for a noninvolved worker and the public (maximally exposed offsite individual and the general population living within 80-kilometers [50 miles] of the facility). **Table 5–31** shows the accident risks, obtained by multiplying the consequences by the likelihood (frequency per year) that an accident could occur. The accidents listed in these tables were selected from a wide spectrum of accidents described in the *TA-18 BIO* (DOE 2001a). The selection process and screening criteria used (see Appendix C) ensure that the accidents chosen for evaluation in this EIS bound the impacts of all reasonably foreseeable accidents that could occur at TA-18 facilities. Thus, in the event that any other accident not evaluated in this EIS were to occur, its impacts on workers and the public would be expected to be within the range of the impacts evaluated.

Consideration has also been given to the possibility of an accident originating with the collocated DAF operations that could initiate an accident at the relocated TA-18 operations at DAF. Because of the robust DAF structure, it was determined that a nuclear yield from DAF operations would be the only accident that could impact the relocated TA-18 operations. However, because of the extremely small likelihood and extremely high consequences of a nuclear yield if it were to occur, the contribution to such consequences of any release at TA-18 operations would be relatively inconsequential.

The accident with the highest risk to the offsite population (see Table 5–31) would be a high-pressure spray fire on a Planet assembly with a plutonium core accident. The increased number of latent cancer fatalities in the offsite population would be 7.7×10^{-10} per year (i.e., about 1 chance in 1.3 billion per year of a latent cancer fatality). The highest risk of a latent cancer fatality to the maximally exposed offsite individual would be 2.5×10^{-12} per year (i.e., about 1 chance in 400 billion per year of a latent cancer fatality). The highest risk of a latent cancer fatality to a noninvolved worker located at a distance of 100 meters (109 yards) from the accident would be 4.0×10^{-9} per year (i.e., about 1 chance in 250 million per year of a latent cancer fatality).

Table 5–30 Accident Frequency and Consequences under the NTS Alternative

	Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population [a]		Noninvolved Worker	
		Dose (millirem)	Latent Cancer Fatalities [b]	Dose (person-rem)	Latent Cancer Fatalities [c]	Dose (millirem)	Latent Cancer Fatalities [b]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core accident							
	1.0×10^{-6}	6.3×10^{-5}	3.13×10^{-8}	0.016	8.0×10^{-6}	1.52	0.00061
Bare, fully reflected or moderated metal criticality accident							
	1.0×10^{-4}	2.2×10^{-12}	1.09×10^{-15}	2.5×10^{-10}	1.2×10^{-13}	2.5×10^{-8}	1.0×10^{-11}
High-pressure spray fire on a Comet machine with a plutonium core accident							
	1.0×10^{-6}	0.005	2.5×10^{-6}	1.55	0.00077	1.0	0.004
Earthquake-induced facility failures without fire accident							
	1.0×10^{-4}	2.6×10^{-6}	1.3×10^{-9}	0.00089	4.4×10^{-7}	0.064	2.6×10^{-5}

[a] Based on a population of 18,074 persons residing within 80 kilometers (50 miles) of the site.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

Table 5–31 Annual Cancer Risks Due to Accidents under the NTS Alternative

Accident	Maximally Exposed Offsite Individual [a]	Offsite Population [b, c]	Noninvolved Worker [a]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	3.1×10^{-14}	8.0×10^{-12}	6.1×10^{-10}
Bare, fully reflected or moderated metal criticality	1.1×10^{-19}	1.2×10^{-17}	1.0×10^{-15}
High-pressure spray fire on a Comet machine with a plutonium core	2.5×10^{-12}	7.7×10^{-10}	4.0×10^{-9}
Earthquake-induced facility failures without fire	1.3×10^{-13}	4.4×10^{-11}	2.6×10^{-9}

[a] Increased risk of a latent cancer fatality.
[b] Risk of increased number of latent cancer fatalities.
[c] Based on a population of 18,074 persons residing within 80 kilometers (50 miles) of the site.

Hazardous Chemicals and Explosives Impacts—There would be no hazardous chemicals or explosives used or stored at the new or modified NTS facilities, other than minor industrial quantities, that would impact workers or the public under accident conditions.

Involved Worker Impacts

Approximately 50 workers would be located at DAF. During criticality experiments, workers would be safely located beyond a prescribed distance from the experiments.

Workers in the vicinity of an accident could be at risk of serious injury or fatality. The impacts from the uncontrolled reactivity insertion on the Comet or Planet assemblies with a plutonium core would be typical of worker impacts during accident conditions.

Facility operating procedures prohibit personnel from being in the test facility during remote operation of the Comet or Planet assemblies. If an accident were to occur during a test run due to improper experiment setup and/or a combination of operator errors from the control room, the involved workers would be in the remote-control room and no workers would be present in the test facility. Workers in the remote-control room would be protected by a combination of shielding and distance from the immediate impacts of the accident. The remote-control room engineered safety features and/or protective actions taken by the control-room staff to limit contamination of the control-room environment would protect the involved workers.

In the event that workers in the bay area setting up the test initiate a criticality accident, it is anticipated these workers would be subject to serious injury or fatality as a result of the accident. Since the facility operating procedures would not prohibit workers from being in adjacent areas during operations, it is anticipated that workers in the vicinity outside of the bay would receive an estimated dose of less than 200 millirem after an uncontrolled criticality event. (This is estimated based on the potential energy released during this accident in relation to that used to design the shielding requirements.)

Following initiation of accident/site emergency alarms, workers would evacuate the area in accordance with site emergency operating procedures and would not be vulnerable to additional risk of radiological injury.

5.4.11 Environmental Justice

Construction Impacts—There would be no disproportionately high and adverse environmental impacts on minority and low-income populations due to construction under the NTS Alternative. As stated in other subsections of Section 5.4, environmental impacts from construction would be small and would not be expected to extend beyond the NTS site boundary.

Normal Operations Impacts—No disproportionately high and adverse environmental impacts on minority and low-income populations would occur under the NTS Alternative. This conclusion is a result of analyses presented in this EIS that determined there were no significant impacts on human health, ecological, cultural, paleontological, socioeconomic, and other resource areas described in other subsections of Section 5.4.

During normal operations, approximately 10 curies of the noble gas argon-41 could be activated in the atmosphere. The impacts measured in terms of latent cancer fatalities on the general population would be small, as indicated in Table 5–29. Additionally, subsistence consumption of crops and wildlife radiologically contaminated with argon-41 would not be harmful since argon-41 has a half-life of 1 hour and 48 minutes and decays into a stable isotope of potassium that is not harmful to human health in small quantities.

Columns 2 and 3 of Table 5–31 show the radiological risks to the maximally exposed offsite individual and offsite population, respectively, that could result from postulated accidents under the NTS Alternative. All of these risks are essentially 0. Hence, none of the postulated accidents would pose a significant radiological risk to the public, including minority and low-income individuals and groups within the population at risk.

5.4.12 Waste Management

In accordance with the Records of Decision for the *Waste Management PEIS* (DOE 1997a), waste could be treated and disposed of on site at NTS or at other DOE sites or commercial facilities. Based on the Record of Decision for hazardous waste published on August 5, 1998 (63 FR 41810), nonwastewater hazardous waste will continue to be treated and disposed of at offsite commercial facilities. Based on the Record of Decision for low-level radioactive and mixed low-level radioactive waste published on February 18, 2000 (65 FR 10061), minimal treatment of low-level radioactive waste will be performed at all sites, and, to the extent practicable, onsite disposal of low-level radioactive waste will continue. Hanford and NTS will be made available to all DOE sites for disposal of low-level radioactive waste. Mixed low-level radioactive waste analyzed in the *Waste Management PEIS* will be treated at Hanford, INEEL, the Oak Ridge Reservation, and the Savannah River Site and will be disposed of at Hanford and NTS.

It is assumed in this EIS that low-level radioactive waste, mixed low-level radioactive waste, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current and developing site practices. No high-level radioactive or transuranic waste is generated from the activities conducted for the TA-18 operations.

Construction Impacts—Only nonhazardous waste is expected to be generated from the construction activities related to relocation of the TA-18 operational capabilities and materials in and around the existing DAF at NTS. The impacts on the NTS waste management systems, in terms of managing the waste, are discussed in this section. Radiological and chemical impacts on workers and the public from waste management activities are included in the public and occupational health and safety impacts provided in Section 5.4.10.

Solid nonhazardous waste generated from construction activities would be disposed of at the onsite construction and demolition landfill, the 9 U-10c Solid Waste Disposal Site. Approximately 1,000 cubic meters (1,300 cubic yards) of solid nonhazardous waste would be generated from the construction activities (NTS 2001). This waste represents about 0.10 percent of the disposal capacity of the 9 U-10c Solid Waste Disposal Site—990,000 cubic meters (1,300,000 cubic yards).

Sanitary wastewater generated from construction activities would be managed using portable toilets currently located at DAF (NTS 2001).

Operations Impacts—The expected generation rates of waste at NTS associated with the relocation of TA-18 operational capabilities and materials to a new location at NTS are compared with NTS's treatment, storage, and disposal capacities in **Table 5–32**. The impacts on the NTS waste management systems, in terms of managing the waste, are discussed in this section. Radiological and chemical impacts on workers and the public from waste management activities are included in the public and occupational health and safety impacts provided in Section 5.4.10.

Table 5–32 Operations Waste Management Impacts under the NTS Alternative

Waste Type [a]	*Estimated Waste Generation for TA-18 Mission Operations (cubic meters per year)*	*Estimated Waste Generation as a Percent of* [b]		
		Onsite Treatment Capacity	*Onsite Storage Capacity*	*Onsite Disposal Capacity*
Low-Level Radioactive Waste				
Liquids	0	0	0	0
Solids	145	Not applicable	Not applicable	0.72
Mixed Low-Level Radioactive Waste				
Liquids	0	0	0	0
Solids	1.5	Not applicable	3.3	0.002
Hazardous Waste				
Liquids	0	0	0	0
Solids	4 (4,000 kilograms per year)	Not applicable	Not applicable	Not applicable
Nonhazardous Waste				
Sanitary wastewater	6,900 [c]	(d)	Not applicable	(d)
Solids	0	0	0	0

[a] See definitions in Chapter 8.
[b] The estimated amounts of waste generated annually are compared with the annual site treatment capacities. The estimated total amounts of waste generated over the assumed 25-year operating period are compared with the site storage and disposal capacities.
[c] Based on the assumption of 100 workers generating 50 gallons per day.
[d] This sanitary wastewater would be managed using existing septic tank systems.
Note: To convert from cubic meters per year to cubic yards per year, multiply by 1.308; to convert from kilograms to pounds, multiply by 2.2.
Not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on site, or is not held in long-term storage).

Solid low-level radioactive waste generated from TA-18 operations at NTS would be sent to the Area 5 Radioactive Waste Management Site for characterization and certification prior to disposal at the Areas 3 and 5 Radioactive Waste Management Site. Approximately 3,600 cubic meters (4,700 cubic yards) of low-level radioactive waste would be generated from these operations activities. This waste represents about 0.72 percent—500,000 cubic meters (650,000 cubic yards)—of the Areas 3 and 5 Radioactive Waste Management Site disposal facility. The impacts of managing this waste at NTS would be minimal.

Mixed low-level radioactive waste generated from TA-18 operations at NTS would be sent to the Area 5 Transuranic Waste Storage Pad for characterization and identification of appropriate treatment. Once the waste meets, or has been treated to meet, land disposal restriction requirements, the waste would be sent to Pit 3 in Radioactive Waste Management Site Area 5 for disposal. The mixed low-level radioactive waste generated from TA-18 operations would be managed in accordance with the NTS site treatment plan. About 38 cubic meters (50 cubic yards) of mixed low-level radioactive waste would be generated over the 25-year operating period of conducting TA-18 mission activities at NTS. This waste represents about 3.3 percent of the mixed low-level radioactive waste storage capacity at NTS—1,150 cubic meters (1,500 cubic yards)—and about 0.002 percent of the mixed low-level radioactive waste disposal capacity at NTS—118,908 cubic meters (160,000 cubic yards). The impacts of managing this waste at NTS would be minimal.

Hazardous waste generated from TA-18 operations at NTS would be sent to the Area 5 RCRA-permitted Hazardous Waste Storage Unit and shipped off site to a commercial RCRA-permitted facility for treatment and disposal. The annual estimate of 4 cubic meters (5 pounds) per year represents about 12 percent of the annual hazardous waste generation rate—34.6 cubic meters (45.2 cubic yards) per year for the entire NTS site. The impacts of managing this waste at NTS would be minimal.

Approximately 6,900 cubic meters (9,000 cubic yards) per year of sanitary wastewater would be generated from the relocation of TA-18 operational capabilities and materials at NTS. This sanitary wastewater would be managed using existing septic tank systems. The impacts of managing this waste at NTS would be minimal.

5.4.13 Transportation Impacts

The transportation impact analysis was carried out as described in Appendix D. Under the NTS Alternative, approximately 92 shipments of radioactive material from TA-18 would be relocated to NTS. The total distance traveled on public roads by trucks carrying radioactive material would be 307,000 kilometers (192,000 miles).

Incident-Free Transportation Impacts—The dose to transportation workers from all transportation activities under this alternative was calculated at 0.25 person-rem; the dose to site workers involved in packaging and loading at TA-18 and unloading and unpacking at NTS was calculated at 2.3 person-rem; and the dose to the public was calculated at 0.33 person-rem. Accordingly, incident-free transportation of radioactive material would result in 0.00010 latent cancer fatalities among transportation workers; 0.0009 latent cancer fatalities among site workers; and 0.00016 latent cancer fatalities in the total affected population over the duration of the transportation activities. The number of nonradiological fatalities from vehicular emissions associated with this alternative was calculated to be 0.00028.

Transportation Accident Impacts—Estimates of total transportation accident risks under the NTS Alternative are as follows: a collective dose to the affected population of 0.000028 person-rem, resulting in 1.4×10^{-8} latent cancer fatalities; a traffic accident, resulting in 0.000031 traffic fatalities; and a dose of 139 rem to a hypothetical maximally exposed individual located 33 meters (108 feet) directly downwind from a most severe accident (severity category 8) with a release frequency of 5×10^{-7} per year, leading to a risk of 0.07 of developing a latent cancer fatality.

5.4.14 Cumulative Impacts

The projected incremental environmental impacts of implementing the proposed action at NTS were added to the environmental impacts of other present and reasonably foreseeable future actions at or near NTS to obtain cumulative site impacts under normal operations. Impacts from ongoing actions have been included in the affected environment conditions described for NTS and presented in Chapter 4, Section 4.4.

Impacts from other reasonably foreseeable future actions at SNL/NM include those presented in the *NTS SWEIS* (DOE 1996e) and the *Final Environmental Assessment for Atlas Relocation and Operation at the Nevada Test Site* (DOE 2001c), which are described along with other relevant NEPA reviews in Sections 1.4.1.4 and 1.4.1.14, respectively. The proposed action for the relocation of Atlas to NTS involves the disassembly of the Atlas Facility and machine at LANL and transport to NTS. At NTS, Atlas would be reassembled in a new building within an existing Area 6 Industrial, Research, and Support site. After Atlas is reassembled at NTS, it would be recommissioned to ensure proper operation and then used to conduct approximately 40 pulsed-power experiments each year, with a potential to increase to approximately 100 experiments per year. At full operation, the Atlas Facility is estimated to employ 15 people, mostly engineers and scientists. Impacts from this action were factored into estimates of total cumulative impacts, where possible, for the potentially affected resource areas presented in this section.

Cumulative transportation impacts were determined by analyzing the impacts along the various routes used to transport the materials associated with relocated TA-18 activities over the 25-year operating period. The methodology for assessing cumulative impacts is presented in Appendix F.

In this section, cumulative site impacts are presented only for those "resources" at a site that may reasonably be expected to be affected by the proposed action. These include site employment, electrical consumption, water usage, air quality, waste management, and public and occupational health and safety. This section also includes the cumulative impacts associated with intersite transportation.

Resource Requirement Impacts—Cumulative impacts on key resource requirements at NTS would be very small. Use of all major resources would remain within the NTS site capacity. The proposed relocation of TA-18 missions would require an increase in the site's use of both electricity and water of approximately 0.1 percent. Cumulatively, with the addition of the TA-18 operations and the proposed action for the relocation of Atlas to Area 6, NTS would use about 58 percent of the available electrical capacity and 16 percent of the available water capacity. Site employment could increase by approximately 35 workers.

Air Quality Impacts—NTS is currently in compliance with all Federal and state ambient air quality standards and would continue to remain in compliance, even after including the cumulative effects of relocated activities at TA-18 and Atlas. The contributions of TA-18 operations to overall site concentrations are expected to be very small.

Public and Occupational Health and Safety–Normal Operations Impacts—Cumulative impacts in terms of radiation exposure to the public and workers at NTS were considered for present and reasonably foreseeable activities. The impacts from the proposed action to relocate Atlas to NTS Area 6 have been determined to be minimal (DOE 2001c). With the additional impact from TA-18 operations at NTS, the cumulative impacts would still be negligible. There would be no increase expected in the number of latent cancer fatalities in the population from site operations if TA-18 security Category I/II operations were to be relocated to NTS. The dose limits for individual members of the public are given in DOE Order 5400.5. As discussed in that order, the dose limit from airborne emissions is 10 millirem per year, as required by the Clean Air Act; the dose limit from drinking water is 4 millirem per year, as required by the Safe Drinking Water Act; and the dose limit from all pathways combined is 100 millirem per year. Therefore, the dose to the maximally exposed offsite individual would be expected to remain well within the regulatory limits. Onsite workers would be expected to have an increase of approximately 0.004 latent cancer fatalities due to radiation from TA-18 operations over the 25-year operating period.

Waste Management Impacts—As presented in Section 5.4.12, relocation of TA-18 operational capabilities and materials at NTS would not generate more than a small amount of additional waste at the site. Similarly, impacts associated with the proposed action for the relocation and operations of the Atlas Facility at Area 6 are also projected to be small, and the cumulative impacts of these combined actions at NTS are expected to be minimal. It is unlikely that there would be major impacts on waste management at NTS because sufficient capacity would exist to manage the site waste.

Transportation Impacts—The cumulative impacts from transportation associated with the relocation of TA-18 operational capabilities and materials are identified in Appendix D. Because likely transportation routes cross many states, cumulative impacts are compared on a national basis. Under the NTS Alternative assessed in this *TA-18 Relocation EIS*, occupational radiation exposure to transportation workers and exposure to the public are estimated to represent less than 0.01 percent of the cumulative exposures from nationwide transportation (DOE 1999d). No additional traffic fatality is expected; the incremental increase in traffic fatalities would be less than 0.0001 percent per year.

5.5 ANL-W ALTERNATIVE

Section 5.5 discusses the environmental impacts associated with the relocation of the TA-18 operational capabilities and materials to the ANL-W site. As discussed in Section 3.3.6, the relocation involves only the security Category I/II activities. The environmental impacts associated with the relocation of SHEBA and other security Category III/IV activities are discussed separately in Section 5.6.

Under the ANL-W Alternative, the TA-18 security Category I/II activities would be relocated to the existing Fuel Manufacturing Facility (FMF)/Zero Power Physics Reactor (ZPPR) Complex at ANL-W, modified internally to accommodate the activities. The alternative also involves the addition of a new structure to FMF for security Category I/II activities and the internal modification of existing buildings at ANL-W to support the security Category I/II activities (see Section 3.3.6).

5.5.1 Land Resources

5.5.1.1 Land Use

Construction Impacts—Under this alternative, approximately 0.6 hectares (1.5 acres) of land within ANL-W would be disturbed by construction of new facilities. New construction would involve an addition to FMF and a new General-Purpose Experimental Building (GPEB). Since both new buildings would be within the existing PIDAS, their construction would not represent a change in land use at the site. Additionally, relocation of TA-18 operations to ANL-W would involve the use of ZPPR and either the Experimental Breeder Reactor II (EBR-II) or the Transient Reactor Test (TREAT) facility. The use of these facilities for TA-18 operations would involve only internal modification and, therefore, would not represent a change in land use.

Operations Impacts—Current and projected land use within ANL-W is devoted to nuclear and nonnuclear scientific and engineering experiments for DOE, private industry, and academia (see Section 4.5.1.1). The operations of both newly constructed buildings as well as modified existing buildings in support of TA-18 operations would be compatible with current land use at the site. Thus, impacts on land use would not occur during operations.

5.5.1.2 Visual Resources

Construction Impacts—Activities related to the construction of new buildings at ANL-W (i.e., an addition to FMF and a new GPEB), as well as those related to modification of existing buildings (i.e., ZPPR and either EBR-II or TREAT), would result in a change to the visual appearance of the site due to the presence of construction equipment and possibly increased dust. These changes would be temporary and, due to the isolated location of ANL-W, would be unlikely to be visible from areas beyond INEEL.

Operations Impacts— Once operational, new buildings at ANL-W would not be noticeably different than other existing structures and, therefore, would not change the appearance of the site. Modifications to existing buildings would not represent a change in the appearance of the area. Thus, the current Class IV Bureau of Land Management Visual Resource Management rating of ANL-W would not change, and there would be no impact on visual resources at either ANL-W or INEEL.

5.5.2 Site Infrastructure

The projected demands on key site infrastructure resources associated with site construction under this alternative on an annualized basis are presented in **Table 5–33**. The existing INEEL infrastructure would easily be capable of supporting the requirements primarily associated with modifications to existing and operating ANL-W facilities under this alternative without exceeding site capacities. Although gasoline and diesel fuel would be required to operate construction vehicles, generators, and other construction equipment, fuel would be procured from either current site inventories or off site and, therefore, would not be limiting resource requirements. Impacts on the local transportation network are expected to be negligible.

Table 5–33 Annual Site Infrastructure Requirements for Facility Construction under the ANL-W Alternative

Resource	*Available Site Capacity* [a]	*ANL-W Alternative* [b]	
		Requirement	*Percent of Available Site Capacity*
Electricity			
Energy (megawatt-hours per year)	172,428	13	0.01
Peak load (megawatts)	85	0.03	0.04
Fuel			
Natural gas (cubic meters per year)	Not applicable	0	Not applicable
Gasoline and diesel fuel (liters per year) [c]	10,180,000	Negligible	Negligible
Water (liters per year)	38,171,000,000	49,970	0.0001

[a] Capacity minus the current site requirements, a calculation based on the data provided in Table 4–52, *TA-18 Relocation EIS*.
[b] Reflects additional demand in excess of existing ANL-W facilities proposed for use under this alternative.
[c] Low supplies can be replenished by truck.
Sources: Table 4–52, *TA-18 Relocation EIS*; ANL-W 2001.

Operations Impacts—Resources needed to support facility operations under the ANL-W Alternative are presented in **Table 5–34**. It is projected that existing INEEL and ANL-W infrastructure resources would be adequate to support proposed mission activities over 25 years.

Table 5–34 Annual Site Infrastructure Requirements for Facility Operations under the ANL-W Alternative

Resource	*Available Site Capacity* [a]	*ANL-W Alternative* [b] *Requirement*	*ANL-W Alternative* [b] *Percent of Available Site Capacity*
Electricity			
Energy (megawatt-hours per year)	172,428	2,249	1.3
Peak load (megawatts)	85	0.31	0.4
Fuel			
Natural gas (cubic meters per year)	Not applicable	0	Not applicable
Liquid fuels (liters per year) [c]	10,180,000	Negligible	Negligible
Coal (metric tons per year) [c]	0	0	0
Water (liters per year)	38,171,000,000	6,900,000	0.02

[a] Capacity minus the current site requirements, a calculation based on the data provided in Table 4–52, *TA-18 Relocation EIS*.
[b] Reflects additional demand in excess of existing ANL-W facilities proposed for use under this alternative.
[c] Low supplies can be replenished by truck.
Sources: Table 4–52, *TA-18 Relocation EIS*; ANL-W 2001.

5.5.3 Air Quality

5.5.3.1 Nonradiological Releases

Construction Impacts—Construction of new buildings and modification of existing buildings at ANL-W would result in an increase in air quality impacts from construction equipment, trucks, and employee vehicles. Criteria pollutant concentrations for construction were modeled and compared to the most stringent standards (see **Table 5–35**). The maximum ground-level concentrations that would result from construction would be well below the ambient air quality standards. The maximum concentrations occur along U.S. Highway 20, south of ANL-W. Modeling of construction air quality considered particulate emissions from activity in a construction area of 0.62 hectares (1.5 acres) for security Category I/II activities and emissions from various earthmoving and materials-handling equipment.

Table 5–35 Nonradiological Air Quality Concentrations at the Public Highway under the ANL-W Alternative – Construction

	Averaging Period	*Most Stringent Standard or Guideline (micrograms per cubic meter)* [a]	*Maximum Incremental Concentration (micrograms per cubic meter)* [b]
Carbon monoxide	8 Hours 1 Hour	10,000 40,000	15.7 121
Nitrogen dioxide	Annual	100	0.007
PM_{10}	Annual 24 Hours	50 150	0.025 1.26
Sulfur dioxide	Annual 24 Hours 3 Hours	80 365 1,300	0.001 1.32 10.5

PM_{10} = particulate matter less than or equal to 10 microns in diameter.
[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean PM_{10} standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.
[b] The concentrations were analyzed at locations to which the public has access—the site boundary, public highway, and nearby sensitive areas.
Sources: 40 CFR 50, ANL-W 2001.

Operations Impacts—Under the ANL-W Alternative, small quantities of criteria and toxic air pollutants would be generated from the operation of the emergency diesel generators and other activities at ANL-W. The emissions from the generators would be independent of the activities being performed at ANL-W, since they result primarily from periodic testing. **Table 5–36** summarizes the concentrations of criteria pollutants from operation of the diesel generators. The concentrations are compared to their corresponding ambient air quality standards. The maximum concentrations that would result from operations would occur along U.S. Highway 20, south of ANL-W. No major change in emissions or air pollutant concentrations are expected under this alternative. Therefore, a Prevention of Significant Deterioration increment analysis is not required (see Appendix F, Section F.3.1). In addition, ANL-W is located in an attainment area for criteria air pollutants; therefore, no conformity analysis is required (see Appendix F, Section F.3.2).

Table 5–36 Nonradiological Air Quality Concentrations at the Public Highway under the ANL-W Alternative – Operations

	Averaging Period	*Most Stringent Standard or Guideline (micrograms per cubic meter)* [a]	*Maximum Incremental Concentration (micrograms per cubic meter)* [b]
Carbon monoxide	8 Hours 1 Hour	10,000 40,000	5.27 22
Nitrogen dioxide	Annual	100	0.002
PM_{10}	Annual 24 Hours	50 150	less than 0.001 0.578
Sulfur dioxide	Annual 24 Hours 3 Hours	80 365 1,300	less than 0.001 0.539 3.49

PM_{10} = particulate matter less than or equal to 10 microns in diameter.

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean PM_{10} standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] The concentrations were analyzed at locations to which the public has access—the site boundary, public highway, and nearby sensitive areas.

Sources: 40 CFR 50, ANL-W 2001.

5.5.3.2 Radiological Releases

Construction Impacts—While no radiological releases to the environment are expected in association with construction activities at ANL-W, the potential exists for contaminated soils and possibly other media to be disturbed during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any contamination and would be required to remediate any contamination in accordance with procedures established under INEEL's environmental restoration program.

Operations Impacts—Approximately 10 curies per year of argon-41 would be released from the relocated TA-18 operations at ANL-W (see Section 3.2.1). There would be no other radiological releases from the relocated mission activities. Impacts from radiological releases are described in Section 5.5.10.1.

5.5.4 Noise

Construction Impacts—Construction of new buildings and modification of existing buildings at ANL-W would result in some temporary increase in noise levels near the area from construction equipment and activities. Some disturbance of wildlife near the area may occur as a result of operation of construction equipment. There would be no change in noise impacts on the public as a result of construction activities, except for a small increase in traffic noise levels along routes leading to INEEL from construction employees and material shipments. Noise sources associated with construction at ANL-W are not expected to include loud impulsive sources such as blasting.

Operations Impacts—Noise impacts from operations of the new facilities at ANL-W are expected to be similar to those from existing operations at ANL-W. Although there would be a small increase in traffic and equipment noise (e.g., heating and cooling systems, generators, etc.) near the area, there would be little change in noise impacts on wildlife and little increase in noise impacts on the public outside of INEEL as a result of moving security Category I/II activities to ANL-W.

5.5.5 Geology and Soils

Construction Impacts—Construction associated with relocation of TA-18 operational capabilities and materials under the ANL-W Alternative is expected to disturb a total of approximately 0.6 hectares (1.5 acres) of land within the current ANL-W perimeter. Although some aggregate and other geologic resources (e.g., sand) likely would be required to support construction activities at ANL-W, these resources are abundant throughout INEEL and the surrounding areas. As blasting should not be necessary (no deep excavation work is anticipated), the overall impact on geologic and soil resources would be relatively minor. A site survey and foundation study would be conducted as necessary to confirm site geologic characteristics for facility engineering purposes. The potential also exists for contaminated soils and possibly other media to be encountered during excavation and other site activities. Prior to commencing ground disturbance, DOE would survey potentially affected areas to determine the extent and nature of any contaminated media and remediation required in accordance with the procedures established under the site's environmental restoration program.

As discussed in Section 4.5.5, the Eastern Snake River Plain on which INEEL is situated is a region of relatively low seismicity, although higher rates of seismic activity are indicated for regions in the surrounding Basin and Range Physiographic Province. Ground shaking of Modified Mercalli Intensity VI (see Appendix F, Table F–6) has been reported on the site in the recent past associated with a major earthquake epicentered in the Borah Peak Range northwest of INEEL. Otherwise, relatively few and minor earthquakes have occurred in the area surrounding INEEL. Modified Mercalli Intensity VI shaking typically causes only slight damage to structures, while Modified Mercalli Intensity VII activity would be expected to affect primarily the integrity of inadequately designed or nonreinforced structures, but damage to properly or specially designed or upgraded facilities would not be expected. Nevertheless, two fault segments in the vicinity of INEEL are considered capable. The closest capable fault (the Howe Segment of the Lemhi Fault) is located 31 kilometers (19 miles) northwest of ANL-W. The likelihood of future volcanic activity along the Axial Volcanic Zone during the 25-year project period is considered low. The potential for nontectonic events to affect ANL-W facilities is also low.

As stated in DOE Order 420.1, DOE is required to ensure that nuclear and nonnuclear facilities be designed, constructed, and operated so that workers, the public, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes.

Operations Impacts—The operations of the new and modified buildings at ANL-W would not be expected to result in impacts on geologic and soil resources at INEEL. As discussed above, the proposed new support building and modifications to existing ANL-W buildings would be evaluated, designed, and constructed in accordance with DOE Order 420.1 and sited to minimize the risk from geologic hazards. Thus, site geologic conditions would not likely affect the facilities.

5.5.6 Water Resources

5.5.6.1 Surface Water

Construction Impacts—Surface water would not be used to support the construction of new support buildings or modifications to or renovations of existing buildings at ANL-W. Groundwater is the source of water at ANL-W and across INEEL. There are no natural surface water drainages or other natural water bodies in the vicinity of ANL-W. Therefore, there would be no construction impact on surface water availability. Sanitary wastewater would be generated by construction personnel. As plans include the use of portable toilets, there would be no onsite discharge of sanitary wastewater and no impact on surface waters. Waste generation and management activities are detailed in Section 5.5.12.

The potential for storm-water runoff from construction areas to impact downstream surface water quality is small. Surface drainages in the vicinity of ANL-W are poorly defined and ephemeral, while infiltration to the subsurface is relatively rapid on unconsolidated sediment. Further, the closest major surface water drainage is more than 20 kilometers (12 miles) west of ANL-W. Any effects on runoff quality would likely be very localized and of short duration. Appropriate soil erosion and sediment control measures (e.g., sediment fences, stacked haybales, mulching disturbed areas, etc.) and spill prevention practices would be employed during construction to minimize suspended sediment and material transport and potential water quality impacts. ANL-W is not located in an area prone to flooding.

Operations Impacts—No impacts on surface water resources are expected as a result of facility operations at ANL-W under this alternative. No surface water would be used to support facility activities and there would be no discharge of sanitary or industrial effluent to surface waters. Sanitary wastewater would be generated as a result of facility operations stemming from facility staff use of lavatory, shower, and break-room facilities and from miscellaneous potable and sanitary uses. Nevertheless, it is planned that this wastewater would be collected and conveyed to existing wastewater treatment facilities. In addition, no industrial or other NPDES-regulated discharges to surface waters are anticipated. Waste generation and management activities are detailed in Section 5.5.12. Overall, operational impacts on site surface waters and downstream water quality would be expected to be negligible.

5.5.6.2 Groundwater

Construction Impacts—Water would be required during construction for uses such as dust control and soil compaction, washing and flushing activities, and to meet the potable and sanitary needs of construction employees. Water use by construction personnel would be greatly reduced over that normally required by the proposed use of portable toilets. In addition, concrete and the water required for concrete mixing likely would be procured off site. As a result, it is estimated that construction activities would require only about 50,000 liters (13,200 gallons) of groundwater on an annualized basis (see Table 5–33), mainly to support new construction and additions to existing ANL-W buildings. It is currently anticipated that this water would be derived from the ANL-W groundwater distribution system via a temporary service connection or trucked to the point of use, especially during the early stages of construction. The relatively small volume of groundwater required during the period of construction compared to site availability and historic usage indicates that construction withdrawals should not have an additional impact on regional groundwater levels or availability. As the depth of groundwater is some 195 meters (640 feet), construction dewatering would not be required.

There would be no onsite discharge of wastewater to the surface or subsurface, and appropriate spill prevention controls, countermeasures, and procedures would be employed to minimize the chance for petroleum, oils, lubricants, and other materials used during construction to be released to the surface or subsurface and to ensure that waste materials are properly disposed of. Waste generation and management activities are detailed in Section 5.5.12. In general, no impact on groundwater availability or quality is anticipated.

Operations Impacts—Buildings housing the relocated TA-18 operations at ANL-W under this alternative would use groundwater primarily to meet the potable and sanitary needs of facility support personnel, as well as for miscellaneous building mechanical uses. It is estimated that about 6.9 million liters (1.8 million gallons) of water would be required annually for facility operations. As this demand would be a small fraction of existing INEEL and ANL-W usage and would not exceed site availability (see Table 5–34), no additional measurable impact on regional groundwater levels or availability would be anticipated.

No sanitary or industrial effluent would be directly discharged to the surface or subsurface. Waste generation and management activities are detailed in Section 5.5.12. Thus, no operational impacts on groundwater quality would be expected.

5.5.7 Ecological Resources

5.5.7.1 Terrestrial Resources

Construction Impacts—Under this alternative, approximately 0.6 hectares (1.5 acres) of land within ANL-W would be disturbed by construction of an addition to FMF, as well as a new GPEB. Since all new construction would take place within previously disturbed areas of ANL-W, no natural habitat would be lost. Further, because wildlife use of the area to be disturbed is limited, direct impacts on wildlife from construction would be minimal. All construction activities would take place within the existing PIDAS; therefore, direct human disturbance to offsite wildlife and wildlife habitat, such as might be caused by the movement of equipment, would not occur. Indirect impacts on wildlife living adjacent to the site would be limited to temporary disturbance from construction noise.

Operations Impacts—Operations of facilities associated with relocated TA-18 operations would not be expected to impact either wildlife or wildlife habitat at ANL-W because relocated TA-18 mission facilities would not produce emissions or effluent at levels that would affect wildlife.

5.5.7.2 Wetlands

Construction and Operations Impacts—There are no wetlands located within or adjacent to those areas of ANL-W that would be disturbed by construction of TA-18 relocation buildings; therefore, this resource would not be affected during either construction or operations. For the same reason, modification of existing buildings at ANL-W also would not have an impact on wetlands.

5.5.7.3 Aquatic Resources

Construction and Operations Impacts—There are no aquatic resources located within or adjacent to those areas of ANL-W that would be disturbed by construction of TA-18 relocation buildings; therefore, this resource would not be affected during either construction or operations. For the same reason, modification of existing buildings at ANL-W required to support TA-18 operations also would not have an impact on aquatic resources.

5.5.7.4 Threatened and Endangered Species

Construction and Operations Impacts—Under the ANL-W Alternative, there would be no impact on threatened or endangered species at ANL-W. All construction would occur on previously disturbed land. Operations would not impact threatened or endangered species because relocated TA-18 operations would not produce emissions or effluent of quality or at levels that would likely affect these species.

5.5.8 Cultural and Paleontological Resources

5.5.8.1 Prehistoric Resources

Construction and Operations Impacts—Although a number of prehistoric finds have been located near ANL-W, the site itself is highly disturbed and is not likely to yield significant archaeological material (see Section 4.5.8.1). Thus, neither construction of new facilities (i.e., an addition to FMF and the GPEB) or renovation of existing buildings (i.e., ZPPR and EBR-II or TREAT) in support of relocated TA-18 missions would be likely to impact prehistoric resources. Nevertheless, prior to construction, a cultural resource survey would be conducted of the areas to be disturbed. If prehistoric resources were discovered during construction, all work potentially affecting the resources would stop. This work stoppage would be followed by investigations by qualified cultural resource specialists, any coordination necessary with the State Historic Preservation Office, and development and implementation of measures to salvage these resources. The relocation of TA-18 operational capabilities and materials would not affect prehistoric resources under this alternative.

5.5.8.2 Historic Resources

Construction and Operations Impacts—A number of historic items (e.g., a belt buckle, broken glass) have been found in the vicinity of ANL-W (see Section 4.5.8.2); however, these were located outside of the PIDAS. None of the buildings within ANL-W have been designated as National Historic Landmarks, although EBR-II has been designated as an American Nuclear Society Historical Landmark (DOE 1997b). Use of this facility would not result in alterations that would detract from its historical importance. The relocation of TA-18 operational capabilities and materials would not affect historic resources under this alternative.

5.5.8.3 Native American Resources

Construction and Operations Impacts—Although prehistoric Native American resources have been found in the vicinity of ANL-W (see Section 4.5.8.1), due to the developed nature of the site, the likelihood of discovering undisturbed material during construction of new facilities is slight. Thus, impacts on Native American resources resulting from the relocation of TA-18 missions at ANL-W would not be expected. As noted in Section 5.5.8.1, preconstruction cultural response surveys would be conducted, and if any Native American resources were located during construction, work would stop while appropriate action was taken. The relocation of TA-18 operational capabilities and materials would not affect Native American resources under this alternative.

5.5.8.4 Paleontological Resources

Construction and Operations Impacts—Paleontological resources have not been found in the immediate vicinity of ANL-W (see Section 4.5.8.4); therefore, it is unlikely that these resources would be present within the site itself. Thus, impacts on paleontological resources during construction and operations of relocated TA-18 operations would not be expected.

5.5.9 Socioeconomics

Construction Impacts—Modifications to existing ANL-W facilities and construction of a new building would require a peak construction employment level of 120 workers. This level of employment would generate about 321 indirect jobs in the region around ANL-W. The potential total employment increase of 441 direct and indirect jobs represents an approximate 0.4 percent increase in the workforce and would occur only over the 24 months of construction. It would have no noticeable impact on the socioeconomic conditions of the region of influence.

Operations Impacts—Relocation of the TA-18 operational capabilities and materials associated with security Category I/II activities to ANL-W could result in the permanent relocation or hiring of approximately 20 new employees and a small reduction in employment levels at LANL. This level of employment would generate about 54 indirect jobs in the region around ANL-W. The potential total employment increase of 74 direct and indirect jobs represents an approximate 0.06 percent increase in the workforce. It would have no noticeable impact on the socioeconomic conditions of the region of influence.

5.5.10 Public and Occupational Health and Safety

The assessments of potential radiological impacts associated with the ANL-W Alternative are presented in this section. No chemical-related health impacts are associated with any of these alternatives because only very small quantities of industrial-type chemicals, such as ethanol, isopropyl alcohol, magnesium oxide, phenylphosphine, and xylene, would be used. As stated in the *LANL SWEIS* (DOE 1999b), the quantities of these chemicals that could be released to the atmosphere during normal operations are minor and would be below the screening levels used to determine the need for additional analysis. There would be no operational increase in the use of these chemicals as a result of the proposed action. No chemicals have been identified that would be a risk to members of the public from construction activities associated with the ANL-W Alternative. Construction workers would be protected from hazardous chemicals by adherence to OSHA and EPA occupational standards that limit concentrations of potentially hazardous chemicals. The potential occupational (industrial) impacts on workers during construction and operations were evaluated based on DOE and Bureau of Labor statistic data, and are detailed in Section C.7 of Appendix C. Construction and operations activities under this alternative are expected to result in some injuries but no fatalities to workers for the duration of the proposed action (i.e., about 3 years of construction and 25 years of operations).

Summaries of radiological impacts from normal operations and postulated accidents are presented below. The methodologies used to determine the impacts on the public and on facility workers are presented in Appendix B. Supplemental information associated with normal operations and postulated accidents is provided in Appendices B and C, respectively.

5.5.10.1 Construction and Normal Operations

Construction Impacts—No radiological risks would be incurred by members of the public from construction activities. Construction workers may be at a small risk. They could receive doses above natural background radiation levels from exposure to radiation from other past or present activities at the site. However, these workers would be protected through appropriate training, monitoring, and management controls. Their exposures would be limited to ensure that doses were kept as low as is reasonably achievable.

Operations Impacts—Under this alternative, the only radiological release would be 10 curies per year of argon-41 to the atmosphere from Godiva operations (see Section 5.5.3.2). The associated calculated impacts on the public are presented in **Table 5–37**. The only dose pathway for receptors would be from immersion in the passing plume. To put the doses into perspective, comparisons with natural background radiation levels are included in the table.

As shown in the table, the expected annual radiation dose to the maximally exposed offsite individual member of the public would be much smaller than the limit of 10 millirem per year set by both the EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The risk of a cancer fatality to this individual from annual operations would be approximately 1.1×10^{-10} per year (i.e., about 1 chance in 9 billion per year of a latent cancer fatality). The projected number of fatal cancers to the population within 80 kilometers (50 miles) would be 2.1×10^{-7} per year (i.e., about 1 chance in 4 million per year of a latent cancer fatality).

Table 5–37 Annual Radiological Impacts to the Public from TA-18 Operations at ANL-W

Receptor	***Impact Values***
Population within 80 Kilometers (50 Miles)	
Collective dose (person-rem)	0.00041
Percent of natural background radiation [a]	4.8×10^{-7}
Cancer fatalities [b]	2.1×10^{-7}
Maximally Exposed Offsite Individual	
Dose (millirem)	0.00021
Percent of regulatory dose limit [c]	0.0021
Percent of natural background radiation [a]	5.8×10^{-5}
Cancer fatalities risk [b]	1.1×10^{-10}
Average Individual within 80 Kilometers (50 Miles)	
Dose (millirem)	1.7×10^{-6}
Percent of natural background radiation [a]	4.8×10^{-7}
Cancer fatalities risk [b]	8.6×10^{-13}

[a] The average annual dose from background radiation at ANL-W is 359 millirem (see Section 4.5.11.1); the 239,100 people living within 80 kilometers (50 miles) would receive an annual dose of 85,800 person-rem from the background radiation.
[b] Based on a cancer risk estimate of 0.0005 latent cancer fatalities per person-rem (see Appendix B).
[c] This comparison cannot be made for the population and average individual because there is no standard or limit.

Annual radiological doses to the 100 workers involved with operations of the relocated TA-18 mission facilities under this alternative would average 100 millirem per worker, for a total workforce annual dose of 10 person-rem. The annual doses to individual workers would be well below the DOE limit of 5,000 millirem (10 CFR 835); the DOE Control Level of 1,000 millirem per year, as established in 10 CFR 835.1002; and the recommended Administrative Control Level of 500 millirem (DOE 1999e). An individual worker's annual risk of a fatal cancer is projected to be 4.0×10^{-5} (i.e., about 1 chance in 25,000 per year of a latent cancer fatality), and the projected number of fatal cancers in the workforce from operations would be 0.0040 per year (or 1 chance in 250 that the worker population would experience a fatal cancer per year of operations).

5.5.10.2 Facility Accidents

Under the ANL-W Alternative, the TA-18 operational capabilities and materials would be relocated to existing ANL-W buildings. The ANL-W buildings would be upgraded and modified as required to provide safety features that would reduce the risks of accidents that currently exist at LANL under the No Action Alternative. The accident scenarios described for the No Action Alternative at LANL are considered applicable to the ANL-W buildings, with one exception. Accidents associated with SHEBA are excluded because the SHEBA missions would be moved to LANL's TA-39; its impacts are shown in Section 5.6.3.10. Certain scenario parameter values applicable to the No Action Alternative, such as leak path factors, materials at risk, and the corresponding source term, have been adjusted to reflect improved safety features of the ANL-W buildings.

Radiological Impacts—**Table 5–38** shows the frequencies and consequences of the postulated set of accidents for a noninvolved worker and the public (maximally exposed individual and the general population living within 80 kilometers [50 miles] of the facility). **Table 5–39** shows the accident risks, obtained by multiplying the consequences by the likelihood (frequency per year) that an accident could occur. The accidents listed in these tables were selected from a wide spectrum of accidents described in the *TA-18 BIO* (DOE 2001a). The selection process and screening criteria used (see Appendix C) ensure that the accidents chosen for evaluation in this EIS bound the impacts of all reasonably foreseeable accidents at TA-18 facilities. Thus, in the event that any other accident not evaluated in this EIS were to occur, its impacts on workers and the public would be expected to be within the range of the impacts evaluated.

Table 5–38 Accident Frequency and Consequences under the ANL-W Alternative

		Maximally Exposed Offsite Individual		*Offsite Population* [a]		*Noninvolved Worker*	
	Frequency (per year)	*Dose (rem)*	*Latent Cancer Fatalities* [b]	*Dose (person-rem)*	*Latent Cancer Fatalities* [c]	*Dose (rem)*	*Latent Cancer Fatalities* [b]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core accident							
	1.0×10^{-6}	0.00021	1.1×10^{-7}	0.162	8.1×10^{-5}	1.15	0.00046
Bare, fully reflected or moderated metal criticality accident							
	1.0×10^{-4}	8.3×10^{-12}	4.2×10^{-15}	3.1×10^{-9}	1.6×10^{-12}	2.0×10^{-8}	8.0×10^{-12}
High-pressure spray fire on a Comet machine with a plutonium core accident							
	1.0×10^{-6}	0.015	7.3×10^{-6}	15.4	0.0077	17.9	0.0072
Earthquake-induced facility failures without fire accident							
	1.0×10^{-4}	8.9×10^{-6}	4.4×10^{-9}	0.0090	4.5×10^{-6}	0.049	1.9×10^{-5}

[a] Based on a population of 239,099 persons residing within 80 kilometers (50 miles) of the site.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

Table 5–39 Annual Cancer Risks Due to Accidents under the ANL-W Alternative

Accident	*Maximally Exposed Offsite Individual* [a]	*Offsite Population* [b, c]	*Noninvolved Worker* [a]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	1.1×10^{-13}	8.1×10^{-11}	4.6×10^{-10}
Bare, fully reflected or moderated metal criticality	4.2×10^{-19}	1.6×10^{-16}	8.0×10^{-16}
High-pressure spray fire on a Comet machine with a plutonium core	7.3×10^{-12}	7.7×10^{-9}	7.2×10^{-9}
Earthquake-induced facility failures without fire	4.4×10^{-13}	4.5×10^{-10}	1.9×10^{-9}

[a] Increased risk of a latent cancer fatality.
[b] Risk of increased number of latent cancer fatalities.
[c] Based on a population of 239,099 persons residing within 80 kilometers (50 miles) of the site.

Consideration has also been given to the possibility of an accident originating with the collocated ANL-W operations that could initiate an accident at the facilities of the relocated TA-18 operations. Because of the robust design of the ANL-W facilities that would be used for TA-18 operations and the distance to any nearby facilities, it was determined that there were no reasonably foreseeable collocated accidents.

The accident with the highest risk to the offsite population (see Table 5–39) would be a high-pressure spray fire on a Comet machine with a plutonium core accident. The increased number of latent cancer fatalities in the offsite population would be 7.7×10^{-9} per year (i.e., about 1 chance in 130 million per year of a latent cancer fatality). The highest risk of a latent cancer fatality to the maximally exposed offsite individual would be 7.3×10^{-12} per year (i.e., about 1 chance in 137 billion per year of a latent cancer fatality). The highest risk of a latent cancer fatality to a noninvolved worker located at a distance of 100 meters (109 yards) from the accident would be 7.2×10^{-9} per year (i.e., about 1 chance in 140 million per year of a latent cancer fatality).

Hazardous Chemicals and Explosives Impacts—There would be no hazardous chemicals or explosives used or stored at the new or modified ANL-W buildings, other than minor industrial quantities, that would impact workers or the public under accident conditions.

Involved Worker Impacts

Approximately 100 workers would be located at the ANL-W facility. During criticality experiments, workers would be safely located beyond a prescribed distance from the experiments.

Workers in the vicinity of an accident could be at risk of serious injury or fatality. The uncontrolled reactivity insertion on the Comet or Planet assemblies with a plutonium core would be typical of worker impacts during accident conditions.

Facility operating procedures prohibit personnel from being in the test facility during remote operation of the Comet or Planet assemblies. If an accident were to occur during a test run due to improper experiment setup and/or a combination of operator errors from the control room, the involved workers would be in the remote-control room and no workers would be present in the test facility. Workers in the remote-control room would be protected by a combination of shielding and distance from the immediate impacts of the accident. The remote-control room engineered safety features and/or protective actions taken by the control-room staff to limit contamination of the control-room environment would protect the involved workers.

In the event that workers in the bay area setting up the test initiate a criticality accident, it is anticipated these workers would be subject to serious injury or fatality as a result of the accident. Since the facility operating procedures would not prohibit workers from being in adjacent areas during operations, it is anticipated that workers in the vicinity outside of the bay would receive an estimated dose of less than 200 millirem after an uncontrolled criticality event. (This is estimated based on the potential energy released during this accident in relation to that used to design the shielding requirements.)

Following initiation of accident/site emergency alarms, workers would evacuate the area in accordance with site emergency operating procedures and would not be vulnerable to additional risk of radiological injury.

5.5.11 Environmental Justice

Construction Impacts—There would be no disproportionately high and adverse environmental impacts on minority and low-income populations due to construction under the ANL-W Alternative. As stated in other subsections of Section 5.5, environmental impacts from construction would be small and would not be expected to extend beyond the ANL-W site boundary.

Operational Impacts—No disproportionately high and adverse environmental impacts on minority and low-income populations would occur under the ANL-W Alternative. This conclusion is a result of analyses presented in this EIS that determined there were no significant impacts on human health, ecological, cultural, paleontological, socioeconomic, and other resource areas described in other subsections of Section 5.5.

During normal operations, approximately 10 curies of the noble gas argon-41 could be activated in the atmosphere. The impacts measured in terms of latent cancer fatalities on the general population would be small, as indicated in Table 5–37. Additionally, subsistence consumption of crops and wildlife radiologically contaminated with argon-41 would not be harmful since argon-41 has a half-life of 1 hour and 48 minutes and decays into a stable isotope of potassium that is not harmful to human health in small quantities.

Columns 2 and 3 of Table 5–39 show the radiological risks to the maximally exposed offsite individual and offsite population, respectively, that could result from postulated accidents under the ANL-W Alternative. All of these risks are essentially 0. Hence, none of the postulated accidents would pose a significant radiological risk to the public, including minority and low-income individuals and groups within the population at risk.

5.5.12 Waste Management

In accordance with the Records of Decision for the *Waste Management PEIS* (DOE 1997a), waste could be treated and disposed of on site at ANL-W or at other DOE sites or commercial facilities. Based on the Record of Decision for hazardous waste published on August 5, 1998 (63 FR 41810), nonwastewater hazardous waste will continue to be treated and disposed of at offsite commercial facilities. Based on the Record of Decision for low-level radioactive and mixed low-level radioactive waste published on February 18, 2000 (65 FR 10061), minimal treatment of low-level radioactive waste will be performed at all sites, and, to the extent practicable, onsite disposal of low-level radioactive waste will continue. Hanford and NTS will be made available to all DOE sites for disposal of low-level radioactive waste. Mixed low-level radioactive waste analyzed in the *Waste Management PEIS* will be treated at Hanford, INEEL, the Oak Ridge Reservation, and the Savannah River Site and will be disposed of at Hanford and NTS.

It is assumed in this EIS that low-level radioactive waste, mixed low-level radioactive waste, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current and developing site practices. No high-level radioactive or transuranic waste is generated from TA-18 operations.

Construction Impacts—No radioactive or hazardous waste types are expected to be generated from the modification to the existing ANL-W buildings to relocate the TA-18 operations at ANL-W. The impacts on the ANL-W waste management systems, in terms of managing the waste, are discussed in this section. Radiological and chemical impacts on workers and the public from waste management activities are included in the public and occupational health and safety impacts provided in Section 5.5.10.

A minimum amount of concrete and rebar would be demolished from the existing facilities for the connection of the new facility additions. These materials would be buried in the new bermed areas for the new additions. Any waste generated from the construction activities would not be part of the ANL-W waste stream and would be the responsibility of the construction contractor (ANL-W 2001).

Sanitary wastewater generated during construction activities would be managed using portable toilet systems.

Operations Impacts—The expected generation rates of waste at ANL-W associated with the relocation of the TA-18 operational capabilities and materials to a new location at ANL-W are compared with ANL-W's treatment, storage, and disposal capacities as shown in **Table 5–40**. The impacts on the ANL-W waste management systems, in terms of managing the waste, are discussed in this section. Radiological and chemical impacts on workers and the public from waste management activities are included in the public and occupational health and safety impacts provided in Section 5.5.10.

Table 5–40 Operations Waste Management Impacts under the ANL-W Alternative

Waste Type [a]	*Estimated Waste Generation for TA-18 Mission Operations (cubic meters per year)*	*Estimated Waste Generation as a Percent of* [b]		
		Onsite Treatment Capacity	*Onsite Storage Capacity*	*Onsite Disposal Capacity*
Low-level radioactive waste				
Liquids	0	0	0	0
Solids	145	Not applicable	Not applicable	0.38
Mixed low-level radioactive waste				
Liquids	0	0	0	0
Solids	1.5	0.02	0.02	Not applicable
Hazardous waste				
Liquids	0	0	0	0
Solids	4 4,000 (kilograms per year)	Not applicable	0.04	Not applicable
Nonhazardous waste				
Sanitary wastewater	6,900 [c]	(d)	Not applicable	(d)
Solids	0	0	0	0

[a] See definitions in Chapter 8.
[b] The estimated amounts of waste generated annually are compared with the annual site treatment capacities. The estimated total amounts of waste generated over the assumed 25-year operating period are compared with the site storage and disposal capacities.
[c] Based on the assumption of 100 workers generating 50 gallons per day.
[d] This sanitary wastewater would be discharged to the Sanitary Sewage Lagoons at ANL-W.
Note: To convert from cubic meters per year to cubic yards per year, multiply by 1.308; to convert from kilograms to pounds, multiply by 2.2.
Not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on site, or is not held in long-term storage).

Solid low-level radioactive waste generated from TA-18 operations conducted at the new location at ANL-W would be treated, as necessary, by compaction, size reduction, or stabilization prior to being sent for disposal at the Radioactive Waste Management Complex. The annual amount of solid low-level radioactive waste i.e., 145 cubic meters (190 cubic yards) is estimated as 0.38 percent of the 37,700-cubic-meter-per-year (49,000-cubic-yard-per-year) disposal capacity of the Radioactive Waste Management Complex. Approximately 3,600 cubic meters (4,700 cubic yards) of low-level radioactive waste would be generated from these operations activities over the 25-year operating period. At some future time, low-level radioactive waste would be disposed of off site. The impacts of managing this waste at ANL-W would be minimal.

Mixed low-level radioactive waste generated from TA-18 operations conducted at a new location at ANL-W would be stabilized, packaged, and stored on site for treatment and disposal in a manner consistent with the site treatment plan. Mixed low-level radioactive waste is currently treated on site with some waste shipped to Envirocare of Utah for disposal. The 1.5-cubic-meter (2-cubic-yard) annual estimate of mixed low-level radioactive waste generation represents about 0.02 percent of the 6,500-cubic-meter-per-year (8,500-cubic-yard-per-year) planned capacity of the Advance Mixed Waste Treatment Facility. A total of about 38 cubic meters (50 cubic yards) of mixed low-level radioactive waste would be generated over the 25-year operating period of conducting TA-18 mission activities at ANL-W. This waste represents about 0.02 percent of the 177,300-cubic-meter (231,900-cubic-yard) storage capacity of the Radioactive Waste Management Complex. The impacts of managing this waste at ANL-W would be minimal.

Hazardous waste generated from TA-18 operations conducted at a new location at ANL-W would be packaged in U.S. Department of Transportation-approved containers and shipped off site to permitted commercial recycling, treatment, and disposal facilities. This waste is not typically stored in long-term storage (i.e., more than one year). Approximately 4 cubic meters (5 cubic yards) per year of hazardous waste would be generated. This waste represents about 0.04 percent of the 9,600-cubic-meter (13,000-cubic-yard) capacity of the hazardous waste storage building (including staging). The impacts of managing this waste at ANL-W would be minimal.

Approximately 6,900 cubic meters (9,000 cubic yards) per year of sanitary wastewater would be generated from the relocation of TA-18 operational capabilities and materials to ANL-W. This sanitary wastewater would be discharged to the Sanitary Sewage Lagoons at ANL-W. The impacts of managing this waste at ANL-W would be minimal.

5.5.13 Transportation Impacts

The transportation analysis was carried out as described in Appendix D. Under the ANL-W Alternative, approximately 92 shipments of radioactive materials from TA-18 would be relocated to ANL-W. The total distance traveled on public roads by truck carrying radioactive materials would be 345,000 kilometers (215,000 miles).

Incident-Free Transportation Impacts—The dose to transportation workers from all transportation activities under this alternative was calculated at 0.28 person-rem; the dose to site workers involved in packaging and loading at TA-18 and unloading and unpacking at ANL-W was calculated at 2.3 person-rem; and the dose to the public was calculated at 0.39 person-rem. Accordingly, incident-free transportation of radioactive material would result in 0.00011 latent cancer fatalities among transportation workers; 0.0009 latent cancer fatalities among site workers; and 0.00019 latent cancer fatalities in the total affected population over the duration of the transportation activities. The number of nonradiological fatalities from vehicular emissions associated with this alternative was calculated to be 0.00062.

Transportation Accident Impacts—Estimates of total transportation accident risks under the ANL-W Alternative are as follows: a collective dose to the affected population of 0.000038 person-rem, resulting in 1.9×10^{-8} latent cancer fatalities; a traffic accident, resulting in 0.00054 traffic fatalities; and a dose of 139 rem to a hypothetical maximally exposed individual located 33 meters (108 feet) directly downwind from a most severe accident (severity category 8) with a release frequency of 6×10^{-7} per year, leading to a risk of 0.07 of developing a latent cancer fatality.

5.5.14 Cumulative Impacts

The projected incremental environmental impacts of implementing the proposed action at ANL-W were added to the environmental impacts of other present and reasonably foreseeable future actions at or near ANL-W to obtain cumulative site impacts under normal operations. Other ongoing actions have been included in the baseline impacts presented in Chapter 4. Potential cumulative impacts from other reasonably foreseeable future actions include those presented in the *Idaho National Engineering and Environmental Laboratory Advanced Mixed Waste Treatment Project Final Environmental Impact Statement* (DOE 1999a); the *Draft Idaho High-Level Waste and Facilities Disposition Environmental Impact Statement* (DOE 1999j); the *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (DOE 2000e); and the *Nuclear Infrastructure Programmatic EIS* (DOE 2000k). Additional NEPA documents related to ANL-W and INEEL that are considered in the cumulative impacts analysis include:

> The *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE 1995c). This programmatic EIS is a complex-wide evaluation of the alternatives for managing the existing and projected amounts of spent nuclear fuel within the DOE inventory through 2035. The EIS contains an analysis of the impacts of transporting spent nuclear fuel,

as well as sitewide alternatives for environmental restoration and waste management programs at INEEL. In the associated Record of Decision, DOE designated Hanford, INEEL, and the Savannah River Site for regional spent fuel storage and management and made decisions about environmental restoration and waste management activities at INEEL. In March 1996, DOE issued an amendment to the May 1995 Record of Decision to include a decision to regionalize the management of DOE-owned spent nuclear fuel by fuel type, including spent fuel currently stored at Hanford, INEEL, and the Savannah River Site.

The *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* (DOE 1996a). This EIS evaluates the adoption of a joint DOE/U.S. Department of State policy to manage spent nuclear fuel from foreign research reactors, including highly enriched uranium provided by the United States to other countries for research reactors. Management alternatives include a number of implementation options for port selection, transportation, and storage at DOE sites. In the Record of Decision, DOE selected a management policy that returned spent nuclear fuel from various foreign research reactors to the United States using two designated U.S. Ports and management at INEEL and the Savannah River Site.

Cumulative transportation impacts were determined by analyzing the impacts along the various routes used to transport the materials associated with relocated TA-18 activities over the 25-year operating period. The methodology for assessing cumulative impacts is presented in Appendix F.

In this section, cumulative site impacts are presented only for those “resources” at a site that may reasonably be expected to be affected by the proposed action. These include site employment, electrical consumption, water usage, air quality, waste management, and public and occupational health and safety. This section also includes the cumulative impacts associated with intersite transportation.

Resource Requirement Impacts—Cumulative impacts on key resource requirements at ANL-W are presented in **Table 5–41**. As a whole, use of all major resources would remain within the INEEL site capacity. The proposed relocation of TA-18 missions at ANL-W would require a small increase in the site’s use of electricity and water of approximately 0.6 percent and 0.02 percent, respectively. Cumulatively, INEEL would use about 78 percent of the available electrical capacity and about 13 percent of the available water capacity. Site employment could increase by approximately 20 workers.

Table 5–41 Maximum Cumulative Resource Use and Impacts at ANL-W and INEEL

Activities	*Site Employment*	*Electrical Consumption (megawatt-hours per year)*	*Water Usage (million liters per year)*
Existing site activities [a]	7,993	221,772	4,829
SNF Management and INEL Environmental Restoration and Waste Management	–	2,200	2
Foreign Research Reactor SNF Management	–	1,000	2
Waste Management PEIS	–	13,980	194
Advanced Mixed Waste Treatment Project	–	33,000	16
High-Level Radioactive Waste and Facilities Disposition	–	33,000	351
Nuclear Infrastructure Operations	24	Negligible [b]	1.68
New TA-18 Operations	20	2,249	6.9
Total	8,037	307,201	5,403
Total site capacity	Not applicable	394,200	43,000

SNF = spent nuclear fuel, INEL = Idaho National Engineering Laboratory, PEIS = programmatic environmental impact statement.

[a] Reflects current sitewide activities (except that the “Site Employment” value also reflects projected employment from other activities) anticipated to continue during all or part of the 25-year period evaluated for proposed TA-18 operations.

[b] Additional electricity consumption associated with this option would be negligible compared to that associated with existing facility activities.

Note: To convert from liters per year to gallons per year, multiply by 0.264; to convert from megawatt-hours to British thermal units, multiply by 3.42×10^6.

Air Quality Impacts—Cumulative impacts on air quality at ANL-W are presented in **Table 5–42**. ANL-W is currently in compliance with all Federal and state ambient air quality standards and would continue to remain in compliance, even after including the cumulative effects of all activities. The contributions of TA-18 operations to overall site concentrations are expected to be very small.

Table 5–42 Maximum Cumulative Air Pollutant Concentrations at ANL-W for Comparison with Ambient Air Quality Standards

Parameter	*Carbon Monoxide*		*Nitrogen Dioxide*	*PM_{10}*		*Sulfur Dioxide*		
Averaging Period	*8 Hours*	*1 Hour*	*Annual*	*Annual*	*24 Hours*	*Annual*	*24 Hours*	*3 Hours*
Activities								
Existing ANL-W site activities [a] (micrograms per cubic meter)	13	57	1.1	0.018	0.28	0.88	11	62
Additional INEEL contribution [b] (micrograms per cubic meter)	78	206	0.46	0.49	12	0.14	5.3	24
Advanced Mixed Waste Treatment Project [c] (micrograms per cubic meter)	0.85	115	0.34	0.006	4.6	0.012	4.5	25
Sodium-Bonded Spent Nuclear Fuel Project (micrograms per cubic meter)	0	0	0	0	0	0	0	0
HLW & FD [d] (micrograms per cubic meter)	4.2	10	0.19	0.02	0.28	0.57	8.9	42
Nuclear infrastructure operations (micrograms per cubic meter)	0	0	0	0	0	0	0	0
New TA-18 operations	5.27	22	0.002	less than 0.001	0.578	less than 0.001	0.539	3.49
Total concentration (micrograms per cubic meter)	101	410	2.1	0.54	18	1.6	30	156
Standard								
Most stringent standard [e] (micrograms per cubic meter)	10,000	40,000	100	50	150	80	365	1,300

HLW & FD = high-level radioactive waste and facilities disposition.

[a] The contribution from existing ANL-W sources evaluated in the *Final EIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*, Table 3–2 (DOE 2000e, but reanalyzed using the ISCST3 model).

[b] Environmental impacts associated with existing site activities (excluding activities at ANL-W) as shown in the *Idaho High-Level Waste and Facilities Disposition Draft EIS*, Table C.2-14 (DOE 1999j) and in the *Final EIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*, Table 3–2 (DOE 2000e). The activities whose concentrations are provided in this row are anticipated to continue during part or all of the 25-year period evaluated for proposed TA-18 operations.

[c] *Advanced Mixed Waste Treatment Project Final EIS* activities—proposed action with microencapsulation or vitrification, Table 5.7-6 (DOE 1999a).

[d] *Idaho High-Level Waste and Facilities Disposition Draft EIS* site boundary contribution for planning basis option, Table C.2-14 (DOE 1999j).

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

Public and Occupational Health and Safety – Normal Operations Impacts—Cumulative impacts in terms of radiation exposure to the public and workers at ANL-W are presented in **Table 5–43**. There would be no increase expected in the number of latent cancer fatalities in the population from site operations if TA-18 operations were to occur at ANL-W. The dose limits for individual members of the public are given in DOE Order 5400.5. As discussed in that order, the dose limit from airborne emissions is 10 millirem per year, as required by the Clean Air Act; the dose limit from drinking water is 4 millirem per year, as required by the Safe Drinking Water Act; and the dose limit from all pathways combined is 100 millirem per year. Therefore, as is evident in Table 5–43, the dose to the maximally exposed offsite individual would be expected to remain well within regulatory limits. Onsite workers would be expected to see an increase of approximately 0.004 latent cancer fatalities due to radiation from TA-18 operations over the 25-year operating period.

Table 5–43 Maximum Cumulative Radiation Impacts at ANL-W

Impact	*Maximally Exposed Offsite Individual*		*Population Dose within 80 Kilometers (50 Miles)*		*Total Site Workforce*	
	Annual Dose (millirem per year)	***Risk of a Latent Cancer Fatality*** [a]	***Dose (person-rem)***	***Number of Latent Cancer Fatalities*** [a]	***Dose (person-rem per year)***	***Number of Latent Cancer Fatalities*** [a]
Existing site activities [b]	0.008	1.0×10^{-7}	0.075	9.4×10^{-4}	64.9	0.026
Storage and disposition	1.6×10^{-6}	2.0×10^{-11}	1.8×10^{-5}	2.3×10^{-6}	25	0.010
Foreign research reactor spent nuclear fuel	5.6×10^{-4}	7.0×10^{-9}	0.0045	5.6×10^{-5}	33	0.013
Spent nuclear fuel	0.008	1.0×10^{-7}	0.19	2.4×10^{-3}	5.4	0.0022
Advanced Mixed Waste Treatment Project	0.022	2.8×10^{-7}	0.009	1.1×10^{-4}	4.1	0.0016
High-level radioactive waste and facilities disposition	0.002	2.5×10^{-8}	0.10	1.3×10^{-3}	59	0.023
Sodium-bonded spent nuclear fuel	0.002	2.5×10^{-8}	0.012	1.5×10^{-4}	22	0.0088
Nuclear infrastructure operations at the Advanced Test Reactor	0	0	0	0	0	0
New TA-18 operations	1.9×10^{-4}	2.4×10^{-9}	0.00041	5.1×10^{-6}	10	0.004
Total	0.043 [c]	5.3×10^{-7} [c]	0.39	4.9×10^{-3}	223	0.089

[a] These values are calculated based on a 25-year exposure period.
[b] Environmental impacts associated with present activities at ANL-W anticipated to continue during all or part of the 25-year period evaluated for proposed relocated TA-18 operations.
[c] The same individual would not be expected to be the maximally exposed individual for all activities at ANL-W. The location of the maximally exposed individual depends upon where on the site an activity is performed. However, to provide an upper bound of the cumulative impacts to the maximally exposed individual, the impacts from each activity have been summed.
Source: DOE 2000k.

Waste Management

Cumulative amounts of waste generated at ANL-W are presented in **Table 5–44**. It is unlikely that there would be major impacts on waste management at ANL-W because sufficient capacity would exist to manage the site waste. None of the alternatives assessed in this *TA-18 Relocation EIS* would generate more than a small amount of additional waste at ANL-W.

Transportation Impacts—The cumulative impacts from transportation associated with the relocation of TA-18 missions are identified in Appendix D. Because likely transportation routes cross many states, cumulative impacts are compared on a national basis. Under the ANL-W Alternative assessed in this *TA-18 Relocation EIS*, occupational radiation exposure to transportation workers and exposure to the public are estimated to represent less than 0.01 percent of the cumulative exposures from nationwide transportation (DOE 1999d). No additional traffic fatality is expected; the incremental increase in traffic fatalities would be less than 0.0001 percent per year.

Table 5–44 Cumulative Impacts on Waste Management Activities from ANL-W and INEEL Concurrent Activities (cubic meters)

Waste Type	Existing Site Activities [a]	Idaho HLW and Facility Disposition EIS [b]	Treatment and Management of Sodium-Bonded SNF [c]	Nuclear Infra-structure Operations [d]	TA-18 EIS [e]	Total	Site Capacity [f]		
							Treatment (cubic meters per year)	Storage (cubic meters)	Disposal (cubic meters per year)
Low-level radioactive	135,600	15,325	862	35	3,625	155,447	42,363	177,493	69,530
Mixed low-level radioactive	3,767	12,837	40	0	38	16,682	157,092	187,761	NA
Hazardous	1,180	2,457	0	0	100	3,737	NA	9,619	NA
Non-hazardous	124,905	145,262	4,960	0	365,000	640,127	3,200,000	NA	3,062,000

HLW = High-Level Radioactive Waste; SNF = Spent Nuclear Fuel; NA = not applicable (i.e., the majority of the waste is not routinely treated, stored, or disposed of on site).

[a] DOE 2000e: Table 4–67 and Figures 5.4-1 through 5.4-3 and input values for those figures representing the 25-year operating period.

[b] DOE 2000e: Table 4–67, Separations Alternative. Maximum quantities for any alternative.

[c] DOE 2000e: Table 4–18, Alternative 1, Electrometallurgically Treat Blanket and Driver Fuel at ANL-W; 12 years of operations and selected in the Record of Decision (65 FR 56565).

[d] DOE 2000k: 4-122, Alternative 2, Option 7, Use Only Existing Operational Facilities and selected in the Record of Decision (66 FR 7877).

[e] SNL/NM Alternative.

[f] Capacities derived from Table 4–68, *TA-18 Relocation EIS*.

Note: To convert from cubic meters to cubic yards, multiply by 1.308.

Sources: DOE 2000e; Sections 4.5.12 and 5.5.12, *TA-18 Relocation EIS*.

5.6 Relocation of SHEBA and Other Security Category III/IV Activities

SHEBA and other security Category III/IV activities of TA-18 would either be relocated to TA-39 and TA-55, respectively, or remain at TA-18. The locations of TA-39 and TA-55 within LANL are shown in Figure 4–2.

The following sections present a separate complete analysis for the relocation of SHEBA activities to TA-39 and other security Category III/IV activities to TA-55. This analysis includes a discussion on the selection of TA-39 as the proposed site for the relocation of SHEBA. Because TA-55 was chosen for the relocation of security Category III/IV activities to coincide with the relocation of security Category I/II activities, a site selection process was not required. This section also includes a description of facility requirements, operational characteristics, and construction requirements for SHEBA and security Category III/IV activities. The analysis includes a description of the unique affected environment features of TA-39, the portion of TA-55 identified for the security Category III/IV relocation activities (the affected environment of LANL as a whole, TA-18, and the rest of TA-55 are described in Chapter 4), and the environmental impacts resulting from the proposed relocation of SHEBA and other security Category III/IV activities.

5.6.1 Basis for Analysis

The following sections present a discussion on the selection of TA-39 as the proposed site for the relocation of SHEBA. Facility requirements, operational characteristics, and construction requirements for SHEBA and security Category III/IV activities are also presented.

5.6.1.1 Siting Selection for SHEBA

SHEBA and other security Category III/IV activities are currently conducted at TA-18. A major distinguishing characteristic of the SHEBA criticality machine is that it is used to test and calibrate criticality alarm detectors and personal dosimeters. This use requires that the SHEBA machine is operated in a "free-field" environment, i.e., with no radiation shielding. Because TA-18 is very close to the heavily traveled Pajarito Road, many SHEBA operations must be performed at nighttime and require Pajarito Road to be closed. Leaving SHEBA at its current location would offer little advantage, especially if security Category I/II activities were relocated, as the ongoing cost of maintaining an aging infrastructure could exceed the capital costs for new facilities.

To minimize the potential exposure to members of the public and collocated uninvolved workers, some SHEBA operations require Pajarito Road to be closed and a minimal site occupancy at TA-18. A new site that limits public access would allow experiments to be conducted during normal working hours. Maintaining a distance to the public of 800 to 1,000 meters (875 to 1,094 yards) is desirable to limit the requirement for safety-class structures, systems, and components. SHEBA operations require the ability to be controlled remotely, thereby necessitating a control building from which to operate the SHEBA assembly. On the other hand, the operations require simple structures with the usual utilities, such as electricity, water, sewer, and compressed air.

The initial set of technical area criteria for siting SHEBA included relatively low population densities and some utilities. TA-39 was identified as the site for the relocation of SHEBA activities because of its remote location and the availability of existing facilities and utilities that would reduce construction costs. While once used extensively for explosives testing, most of this activity at TA-39 has been transferred to other locations at LANL. Therefore, relocating SHEBA activities to TA-39 would require only a moderate amount of coordination with other existing site activities. A brief discussion of other sites at LANL evaluated for the relocation of SHEBA activities and the reasons they were not considered for detailed analysis follows (their locations at LANL are shown in Figure 4–2):

TA-16—The main deficiency of the TA-16 site is that substantial development of this general area ("Experimental Engineering") is planned. The *LANL Comprehensive Site Plan 2000* (LANL 2000g) specifies that this area is scheduled to contain tritium facilities, explosives facilities, and facilities related to the Advanced Hydrotest Facility. Locating SHEBA in this area would hinder these developments as well as SHEBA's operational efficiency.

TA-49—Proximity to the public is the main deficiency of this site. State Highway 4 is only 500 meters (547 yards) away from this site, and LANL has no control over this state highway.

TA-36—Current and planned use of this area for high-explosives testing is the main deficiency of this site. The high frequency of planned explosives testing would severely impact SHEBA's operational efficiency.

TA-33—This site has several significant deficiencies. The utilities in this area are very limited, the site is close to a popular trail leading to the Rio Grande Valley, and, on several occasions, hikers have walked up into the area.

5.6.1.2 Facilities

The relocation of the SHEBA activities to TA-39 would involve the construction of a new structure on top of an existing bunker (Building 6 at TA-39) or the construction of a new bunker and cover structure at another suitable location at TA-39. The bunker, in both cases, would be used to house the SHEBA solution tanks and support equipment. A new control and training-room structure would either be built along the existing road leading to Building 6 at TA-39 or in relatively close proximity to the construction of the new SHEBA bunker. In either case, it would be outside the SHEBA radiation and existing explosives magazines exclusion zones. Water and gas would be extended to this building, along with the installation of a septic tank and leach field. The location of the existing Building 6 at TA-39 proposed for the relocation of SHEBA is shown in **Figure 5–1**.

The relocation of the security Category III/IV activities to LANL's TA-55 would involve the construction of a new laboratory and a new office building at TA-55 in the proximity of the proposed new underground facility for security Category I/II activities, but outside the PIDAS. The location of these two buildings for the relocation of security Category III/IV activities at LANL's TA-55 is shown in **Figure 5–2**. If a decision is made that security Category III/IV activities remain at TA-18, some internal modifications to TA-18 facilities would be required, but no new construction. Internal modifications would be limited to rearrangement of internal spaces to accommodate the security Category III/IV activities.

5.6.1.3 Operational Characteristics

The operational characteristics of the facilities at TA-18 are provided in Section 3.2.1 and Table 3–2. They include all security Categories (i.e., security Category I/II, SHEBA, and other security Category III/IV activities). The operational characteristics for only SHEBA or security Category III/IV activities cannot be easily separated. Therefore, with the exception of the potential radiological effluent (100 curies per year of argon-41 from SHEBA activities), all other operational characteristics are assumed to be those in Table 3–2.

5.6.1.4 Construction Requirements

Table 5–45 shows the construction requirement parameters used for the environmental impact analysis.

Table 5–45 Construction Requirements to Relocate SHEBA and Security Category III/IV Activities to TA-39 and TA-55, Respectively

	SHEBA		
Requirement	***Existing Bunker***	***New Bunker and Cover Structure***	***New Office and Laboratory Building for Security Category III/IV Activities***
Electrical energy (megawatt-hours)	5.2	5.2	26
Peak electric demand (megawatts)	0.013	0.013	26
Concrete (cubic meters)	40	200	971
Steel (metric tons)	11.2	18.6	302
Fuel/gasoline (liters)	(a)	(a)	(a)
Water (liters)	34,100	34,100	4,660,000
Land (hectares)	0.2	0.2	1.7
Construction Workers			
Peak (workers)	25	25	45
Construction time (months)	6	8	12 to 18

[a] Not provided. Considered to be part of construction cost; contractors are to provide fuel/gasoline needed for their machinery.
Source: LANL 2001a.

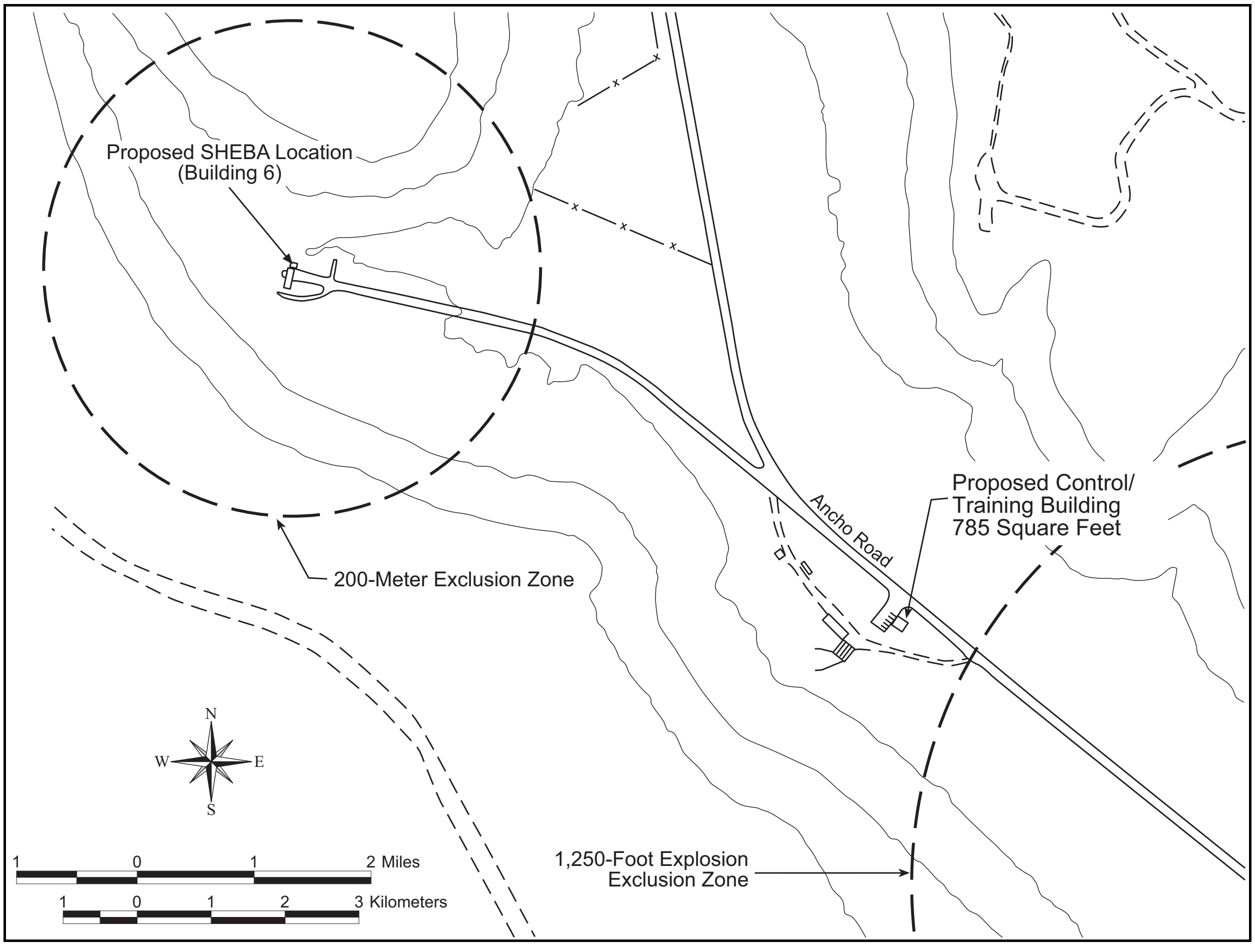


Figure 5–1 Location of the Proposed Facilities for the Relocation of SHEBA at LANL's TA-39

5.6.2 Affected Environment

SHEBA and other security Category III/IV activities would either remain at TA-18 or be relocated to LANL's TA-39 and TA-55, respectively. The affected environment for the relocation of SHEBA and other security Category III/IV activities, therefore, is associated in general with LANL and specifically with TA-18, TA-39, and TA-55.

The affected environment at LANL, including unique features at TA-18 and the part of TA-55 selected for the proposed relocation of security Category I/II activities, was described previously in Chapter 4. Some of the features unique to LANL's TA-39 affected environment and the part of TA-55 selected for the proposed relocation of TA-18 security Category III/IV activities are described below. The following descriptions of the affected environment at LANL's TA-39 and TA-55 are based all or in part on information provided in the *LANL SWEIS* (DOE 1999b).

Land Resources

Land Use—TA-39 is located within the Explosives/Waste Disposal land-use category (see Figure 4–3). It is located in the southeastern part of LANL. TA-39 borders Bandelier National Monument and is about 3.2 kilometers (2 miles) southeast of White Rock, a residential community. The site is used for studying high-energy density properties in experiments using explosives-driven pulsed power. Typically, open-air

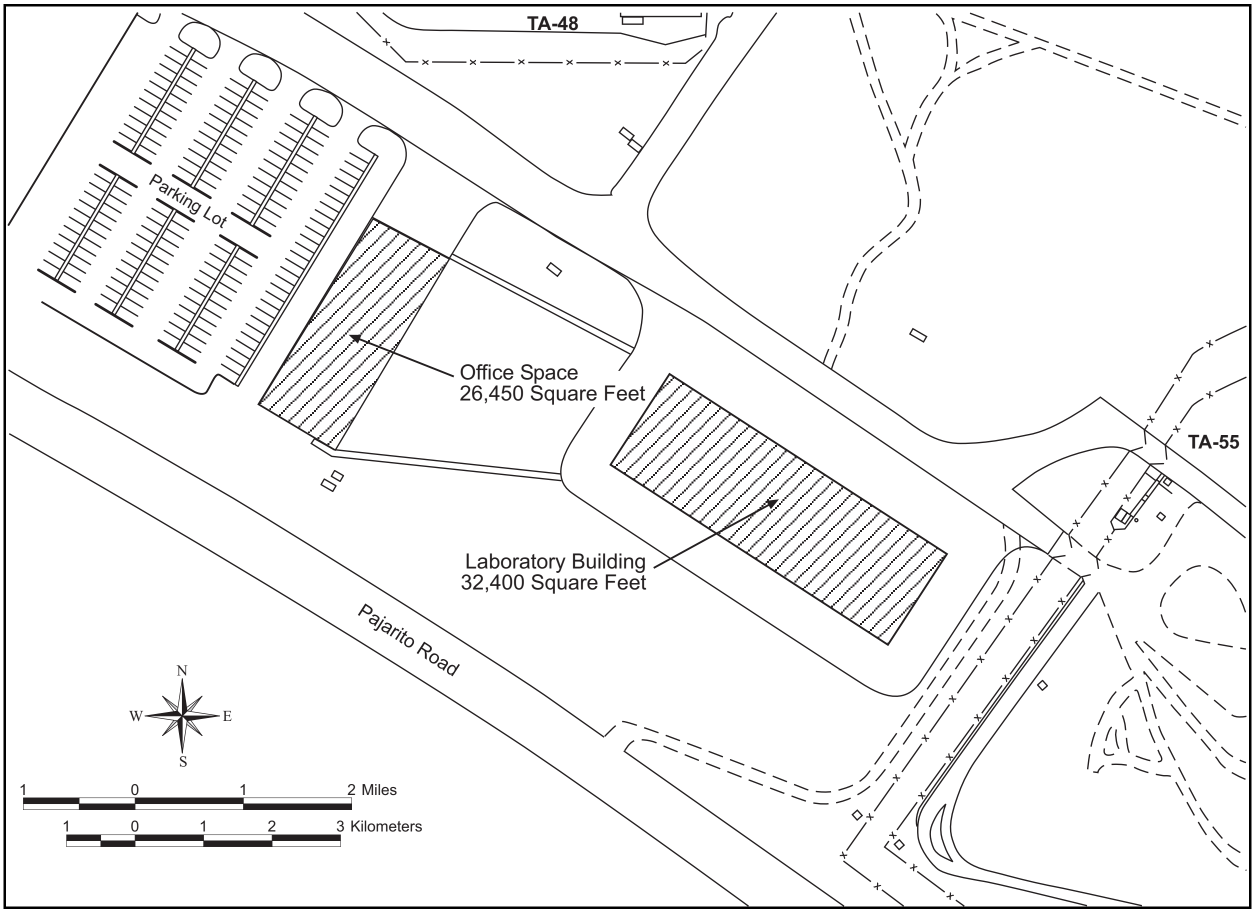


Figure 5–2 Location of the Proposed Facilities for the Relocation of Security Category III/IV Activities at LANL's TA-55

detonation is used, and up to 2,000 kilograms (4,400 pounds) of explosives may be used in a single test. In the past, contained testing involving plutonium was performed at the site. Facilities at TA-39 include offices, laboratories, shops, magazines, firing sites, a gas-gun facility, and a storage and assembly building (DOE 1999b). Test facilities are located at the bottom of Ancho Canyon because the deep canyon and steep walls isolate explosives tests from the public.

Visual Resources—TA-39 is located in the southeastern portion of LANL. Due to topographic variation, the area presents dramatic views of deep canyons with steep walls giving way to mesas at higher elevations. Most of the area is in a natural state with development restricted to a few isolated locations. The Cerro Grande Fire did not burn across TA-39 (DOE 2000h). Developed areas within TA-39 are not visible from offsite locations. Due to the general lack of development at TA-39, the Bureau of Land Management Visual Resource Contrast rating would vary (depending on the specific viewpoint) between Class II and Class III.

Site Infrastructure

Vehicular access to the site is provided by Ancho Road from State Road 4. Utilities including electric power, water, and natural gas serve the TA-39 Ancho Canyon facilities. In fiscal year 2000, TA-39 used 306 megawatt-hours of electricity. Natural gas usage is estimated to be about 45 cubic meters (1,600 cubic feet) per year (LANL 2001a).

Air Quality and Noise

A description of current air quality conditions at LANL, including TA-18, TA-39, and TA-55, was addressed previously in Section 4.2.3. Existing noise sources associated with TA-39 activities that could affect publicly detectable noise levels include vehicles and high-explosives testing. Topographic and geologic features effectively mitigate much of the noise and vibration associated with activities at TA-39. The *LANL SWEIS* discusses these noise sources in further detail. Background noise levels at the adjacent Bandelier National Monument are low, as discussed in Section 4.2.4.

Geology and Soils

The stratigraphy of the TA-39 Ancho Canyon site is expected to be fairly representative of other canyon sites within LANL, with unconsolidated alluvial sediments (e.g., gravel, sand, silt, and clay) comprising the canyon bottom that overlies poorly welded and highly weathered volcanic tuff. Welded tuff typically comprises the canyon walls. Soils derived from these parent materials are typically sandy loams. Three faults associated with the Pajarito Fault Zone (i.e., Pajarito, Rendija Canyon, and Guaje Mountain) are considered capable (10 CFR 100, Appendix A). The closest known fault to TA-39 is the Pajarito Fault, which is located approximately 8 kilometers (5 miles) west of TA-39 (see Figure 4–3 and Section 4.2.5) (DOE 1999b).

Water Resources

Surface Water—There are no natural surface water bodies in the vicinity of the TA-39 Ancho Canyon facilities. The Ancho Canyon arroyo is ephemeral along most of its length as it traverses TA-39 from northeast to southwest. However, it becomes perennial along its lowermost reach to its confluence with the Rio Grande at TA-33 (DOE 1999b). Two NPDES outfalls to Ancho Canyon from TA-39 high-explosives testing facilities were eliminated in 1997 (LANL 2000e, DOE 1999b). Storm-water runoff and surface water quality within Ancho Canyon and other LANL canyons is monitored to evaluate the effects of LANL facility operations (see Section 4.2.6.1).

Groundwater—Groundwater across LANL occurs in the relatively shallow canyon-bottom alluvium as intermediate perched groundwater, and deeper in the main (regional) aquifer. The depth to perched groundwater bodies in the canyons has been found to range from 27 to 137 meters (90 to 450 feet) (DOE 1999b). Monitoring-well R-31 is located in Ancho Canyon at TA-39. The Environmental Restoration Project has also installed numerous shallow wells near landfills at TA-39.

Ecological Resources

Terrestrial Resources—TA-39 is located in the Pinyon-Juniper Woodland vegetation zone. However, vegetation within the area varies with elevation, with pinyon-juniper woodland present in the 1,900- to 2,100-meter (6,200- to 6,900-foot) elevation range and ponderosa pine woodland found in the 2,100- to 2,300-meter (6,900- to 7,500-foot) elevation range (DOE 1996g). Development within TA-39 is restricted to a few isolated locations, a number of which occur along Ancho Road at the bottom of the Ancho Canyon. Vegetation within the canyon is pinyon-juniper woodland. TA-39 was not burned during the Cerro Grande Fire. Wildlife typical of pinyon-juniper woodlands includes the Cassin's kingbird, cliff swallow, coyote, and mule deer. Animals found within the ponderosa pine community at higher elevations of TA-39 include the Western bluebird, solitary vireo, raccoon, and mountain lion (DOE 1999b, DOE 2000h).

Wetlands—There is one wetland located in the southeastern portion of TA-39 where it borders TA-33. The wetland is characterized by vegetation and other components similar to these found in the wetland associated with TA-18 (see Section 4.2.7.2).

Aquatic Resources—There are no aquatic resources within TA-39.

Threatened and Endangered Species—No threatened and endangered species or their critical habitat have been found to date at TA-39.

Cultural and Paleontological Resources

Prehistoric Resources—Based on previous cultural resource surveys, archaeological sites have been identified throughout TA-39. One archaeological site is located to the east-southeast of existing Building 6 and another two archaeological sites are located to the west of the proposed location for the new control and training building in conjunction with relocating SHEBA to Building 6.

Another archaeological site, eligible for nomination to the National Register of Historic Places, is located in a fenced area near the proposed security Category III/IV office building and parking lot at TA-55.

No historic or paleontological resources have been found at TA-39.

Radiation Exposure

Major sources and levels of background radiation exposure to individuals in the vicinity of LANL were previously discussed in Section 4.2.11.1. External radiation doses have been measured in areas surrounding TA-39 that may contain radiological sources for comparison with offsite natural background radiation levels. Measurements taken in 1999 showed an average onsite dose in the vicinity of TA-39 of 183 millirem, compared to an average offsite dose of 126 millirem (LANL 2000f).

Waste Management

Two locations within TA-39, firing sites 6 and 57, currently operate as open detonation sites for treatment of hazardous waste under RCRA interim status. Additionally, there are approximately 25 potential release sites at TA-39, 14 of which are solid-waste management units subject to RCRA corrective action standards and the Hazardous and Solid Waste Amendment provisions of LANL's Hazardous Waste Facility Permit. The latter group includes firing sites 6 and 57. The environmental restoration program's current baseline for cleanup activities at TA-39 will begin in fiscal year 2006. If SHEBA is relocated to Building 6 (firing site 6) at TA-39, the site would require characterization and closure with a potential need for a postclosure permit and associated monitoring.

5.6.3 Environmental Impacts

The following subsections address the environmental impacts associated with the potential relocation of SHEBA from TA-18 to TA-39 and other security Category III/IV activities to TA-55. The environmental impacts associated with the relocation of SHEBA and other security Category III/IV activities at LANL should be considered in conjunction with the impacts associated with the relocation of security Category I/II activities, as discussed in Section 5.2, LANL New Facility Alternative, and Sections 5.3, 5.4, and 5.5. The environmental impacts associated with SHEBA and other security Category III/IV activities remaining at TA-18 are considered to be bounded by the impacts described for the No Action and TA-18 Upgrade Alternatives evaluated in detail in Section 5.2.

5.6.3.1 Land Resources

Land Use

Construction Impacts—A small amount of land (approximately 1.6 hectares [4 acres]) would be disturbed, should SHEBA be relocated to TA-39, regardless of whether SHEBA is located on top of an existing or new bunker building. Water and gas lines and a septic tank and leach field would be needed to support the proposed new control and training building and would use existing utility corridors where possible.

Should security Category III/IV activities be relocated to TA-55, a laboratory, office buildings, and a 200-vehicle parking lot would be built on a 3.2-hectare (8-acre) site located outside of the current TA-55 PIDAS. The construction of these buildings and a parking lot, including a construction lay-down area, would occupy about 1.6 hectares (4 acres) of this site. This proposed action is compatible with the current Research and Development land-use designation of TA-55.

Operations Impacts—Operations of these new facilities would be compatible with current land use at both TA-39 and TA-55, as well as their present land-use designations. Thus, there would be no measurable impact on land use during the operational phase of the proposed action.

Visual Resources

Construction Impacts—Although some impact on visual resources may result from the presence of construction equipment and dust at TA- 39 and TA-55, these impacts would be temporary and not visible at any offsite location.

Operations Impacts—The presence of new buildings and/or modification of Building 6 at TA-39 would result in little change in the appearance of the area. Thus, the overall Class II to Class III Bureau of Land Management Visual Resource Management rating of TA-39 would not change as a result of relocation.

New buildings at TA-55 would add to the visual impact of development at TA-55. While not visible from lower elevations, new development would be visible from higher elevations to the west along the upper reaches of the Pajarito Plateau rim. As a result of the Cerro Grande Fire, visibility of newly built structures (as well as the entire TA-55 area) would be greater than would have been the case before the fire. However, regardless of the effects of the fire, the Class IV Bureau of Land Management Visual Resource Management rating of the area would not change as a result of relocation.

5.6.3.2 Site Infrastructure

Construction Impacts—The projected demands on key infrastructure resources associated with the construction of new SHEBA and security Category III/IV buildings at LANL are presented in **Table 5–46**. Currently, existing LANL infrastructure would be capable of supporting the construction requirements without exceeding site capacities. Although gasoline and diesel fuel would be required to operate construction vehicles, generators, and other construction equipment, it is expected that fuel would be procured from offsite sources and, therefore, is not a limited resource.

Table 5–46 Site Infrastructure Requirements for Facility Construction for Relocation of SHEBA and Other Security Category III/IV Activities

Resource	*Available Site Capacity* [a]	*SHEBA* [b]		*Security Category III/IV* [b]	
		Requirement	*Percent of Available Site Capacity*	*Requirement*	*Percent of Available Site Capacity*
Electricity					
Energy (megawatt-hours per year)	461,132	5.2	0.001	26	0.006
Peak load (megawatts)	24	0.013	0.054	0.026	0.11
Fuel					
Gasoline and diesel (liters per year) [c]	Not limited	Negligible	Not limited	Negligible	Not limited
Water (liters per year)	335,000,000	34,100	0.01	4,656,000	1.4

[a] Capacity minus the current site requirements, a calculation based on the data provided in Table 5–1, *TA-18 Relocation EIS*.
[b] Represents total rather than annualized values as the low-end projected period of construction ranges from 6 months for SHEBA to 12 months for security Category III/IV facilities.
[c] Not limited due to offsite procurement.
Sources: Table 5–1, *TA-18 Relocation EIS*; LANL 2001a.

Operations Impacts—Resources needed to support operation of SHEBA at TA-39 and new security Category III/IV buildings at TA-55 are presented in **Table 5–47**. It is projected that all other existing LANL infrastructure resources would be adequate to support proposed operational activities over 25 years. In general, total infrastructure requirements would be a small fraction of those projected under the No Action Alternative (see Section 5.2.2), with operational demands for security Category III/IV activities not easily separated out and bounded by that alternative. Therefore, they are considered "negligible" for the purpose of analysis.

5.6.3.3 Air Quality

Nonradiological Releases

Construction Impacts—Construction of new buildings and/or modification of an existing building at TA-39 for SHEBA would result in an increase in air quality impacts from construction equipment, trucks, and employee vehicles. Criteria pollutant concentrations for construction of a new building assumed to be located in the central part of TA-39 were modeled and compared to the most stringent standards (see Table 5–48). Concentrations of criteria pollutants from the construction of new buildings at other locations north of the main TA-39 support facilities and along the road are expected to be similar. The maximum ground-level concentrations that would result from construction would be below the ambient air quality standards. The maximum short-term concentrations would occur at receptors to the southwest along the LANL boundary adjacent to Bandelier National Monument. The maximum annual concentrations would occur at a receptor east of TA-39 along Route 4. Modeling of construction air quality considered particulate emissions from activity in a construction area of 0.08 hectares (0.2 acres) and emissions from various earthmoving and materials-handling equipment.

Table 5–47 Site Infrastructure Requirements for Facility Operations for Relocation of SHEBA and Other Security Category III/IV Activities

Resource	Available Site Capacity [a]	SHEBA [b]		Security Category III/IV [b]	
		Requirement	Percent of Available Site Capacity	Requirement	Percent of Available Site Capacity
Electricity					
Energy (megawatt-hours per year)	461,132	Negligible	Negligible	Negligible	Negligible
Peak load (megawatts)	24	Negligible	Negligible	Negligible	Negligible
Fuel					
Natural gas (cubic meters per year)	159,400,000	Negligible	Negligible	Negligible	Negligible
Liquid fuel (liters per year) [c]	Not limited	Negligible	Not limited	Negligible	Not limited
Coal (metric tons per year)	Not applicable	0	Not applicable	0	Not applicable
Water (liters per year)	335,000,000	Negligible	Negligible	Negligible	Negligible

[a] Capacity minus the current site requirements, a calculation based on the data provided in Table 5–1, *TA-18 Relocation EIS*.
[b] Values would be a small fraction of the requirements projected under the No Action Alternative.
[c] Not limited due to offsite procurement.
Sources: Table 5–1, *TA-18 Relocation EIS*; LANL 2001a.

Construction of new buildings at TA-55 for the relocation of TA-18 security Category III/IV activities would result in an increase in air quality impacts from construction equipment, trucks, and employee vehicles. Criteria pollutant concentrations for construction were modeled and compared to the most stringent standards (see **Table 5–48**). The maximum ground-level concentrations that would result from construction would be below the ambient air quality standards, except for short-term concentrations of PM_{10} and total suspended particulates that could be above the standard at receptors adjacent to the site along Pajarito Road. Actual construction concentrations are expected to be less because conservative emission factors and other assumptions were used in the modeling of construction activities and tend to overestimate impacts. The maximum short-term concentrations would occur at a receptor on Pajarito Road adjacent to the construction area. The maximum annual concentrations would occur at a receptor to the north of TA-55 along the LANL boundary. Computer modeling of construction air quality considered particulate emissions from activity in a construction area of 1.7 hectares (4.1 acres) for security Category III/IV activities and emissions from various earthmoving and materials-handling equipment. Measures that could be used to mitigate construction emissions are discussed in Section 5.9.

Modification of buildings and infrastructure to maintain security Category III/IV activities at TA-18 could result in some increase in criteria pollutant emissions and concentrations. These impacts would be bounded by the construction air quality impacts described under the TA-18 Upgrade Alternative in Section 5.2.3.1.

Operations Impacts—Small quantities of toxic air pollutants could be generated from SHEBA and security Category III/IV activities. These emissions are discussed in Section 5.6.3.10, Public and Occupational Health and Safety.

Table 5–48 Nonradiological Air Quality Concentrations at TA-39 for SHEBA and TA-55 for Security Category III/IV Activities – Construction

	Averaging Period	*Most Stringent Standard or Guideline (micrograms per cubic meter)* [a]	*Maximum Incremental Concentration from TA-55 (micrograms per cubic meter)* [b]	*Maximum Incremental Concentration from TA-39 (micrograms per cubic meter)* [b]
Carbon monoxide	8 Hours	7,800	123	71.5
	1 Hour	11,700	703	572
Nitrogen dioxide	Annual	73.7	0.25	0.081
	24 Hours	147	69	19.7
PM_{10}	Annual	50	1.25	0.016
	24 Hours	150	154	2.95
Sulfur dioxide	Annual	41	0.02	0.007
	24 Hours	205	6.62	1.97
	3 Hours	1,030	41.3	15.8
Total suspended particulates	Annual	60	2.47	0.026
	24 Hours	150	303	4.14

PM_{10} = particulate matter less than or equal to 10 microns in diameter.

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (40 CFR 50), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean PM_{10} standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard. Standards and monitored values for pollutants other than particulate matter are stated in parts per million. These values have been converted to micrograms per cubic meter with appropriate corrections for temperature (21 °C [70 °F]) and pressure (elevation 2,135 meters [7,005 feet]), following New Mexico dispersion modeling guidelines (revised 1998) (NMAQB 1998).

[b] The annual concentrations were analyzed at locations to which the public has access—the site boundary and nearby sensitive areas. Short-term concentrations were analyzed at the site boundary and at the fence line of the technical area to which the public has short-term access.

Sources: DOE 1999b, LANL 2001a.

Radiological Releases

Construction Impacts—While no radiological releases to the environment are expected in association with construction activities at TA-39 and TA-55, the potential exists for contaminated soils and possibly other media to be disturbed during excavation and other site activities. Prior to commencing ground disturbance, the National Nuclear Security Administration would survey potentially affected areas to determine the extent and nature of any contamination and would be required to remediate any contamination in accordance with state and Federal regulations, LANL's Hazardous Waste Facility Permit, and procedures established under LANL's environmental restoration program. Remediation would be conducted so that additional soil contamination would be minimized.

Operations Impacts—Approximately 100 curies per year of argon-41 would be released from the relocated SHEBA activities at TA-39 (see Section 3.2.1). There would be no radiological releases from the relocated security Category III/IV activities at TA-55 or at TA-18. Impacts on public and occupational health and safety from radiological releases are described in Section 5.6.3.10.

5.6.3.4 Noise

Construction Impacts—Construction of new buildings at TA-39 and TA-55 would result in some temporary increase in noise levels near the area from construction equipment and activities. Some disturbance of wildlife near the area may occur as a result of the operation of construction equipment. There would be no change in noise impacts on the public as a result of construction activities, except for a small increase in traffic noise levels from construction employees and material shipments. Noise sources associated with construction at TA-39 and TA-55 are not expected to include loud impulsive sources such as blasting.

Operations Impacts—Noise impacts from relocated SHEBA and security Category III/IV activities at TA-39 and TA-55 are expected to be similar to existing operations at these areas. Although there would be a small increase in traffic noise and equipment noise (e.g., heating and cooling systems and generators) near the areas, there would be little change in noise impacts on wildlife and no change in noise impacts on the public outside of LANL as a result of moving these activities to TA-39 and TA-55.

5.6.3.5 Geology and Soils

Construction Impacts—Since less than about 0.2 hectares (0.5 acres) of previously disturbed land would be used to house relocated SHEBA activities, impacts on geology and soils at TA-39 are expected to be negligible. The potential also exists for contaminated soils and possibly other media to be encountered during excavation and other site activities. Prior to commencing ground disturbance, potentially affected areas would be surveyed to determine the extent and nature of any contaminated media and required remediation in accordance with state and Federal regulations, LANL's Hazardous Waste Facility Permit, and procedures established under LANL's environmental restoration program.

Potential overall impacts on geology and soils at TA-55 and TA-39 from construction activities would be minor, with the risk to proposed facilities from large-scale geologic conditions at LANL expected to be similar to that discussed in Section 5.2.5.

Operations Impacts—The operations of relocated SHEBA and other security Category III/IV activities at TA-39 and TA-55, respectively, would not be expected to result in impacts on geologic and soil resources at LANL. The new facilities would be designed and constructed in accordance with DOE Order 420.1 and sited to minimize the risk from geologic hazards. Thus, site geologic conditions would be unlikely to affect the facilities.

5.6.3.6 Water Resources

Surface Water

Construction Impacts—The reach of Ancho Canyon in the vicinity of TA-39 is ephemeral and not a viable source of water, and no surface water would be used to support facility construction. All activities planned for TA-39 would occur on the canyon bottom, and Building 6 is located immediately adjacent to a dry stream bed. There are no natural surface water drainages at TA-55 that would be impacted by security Category III/IV activities. In addition, appropriate soil erosion and sediment control measures (e.g., sediment fences, stacked haybales, mulching disturbed areas, etc.) and spill prevention practices would be employed during construction at both TA-39 and TA-55 to minimize suspended sediment and material transport and any potential downstream water quality impacts. It is expected that portable toilets would be used for construction personnel at both sites, resulting in no onsite discharge of sanitary wastewater and no impact on surface waters.

Operations Impacts—Relocated SHEBA and other security Category III/IV activities at TA-39 and TA-55, respectively, would not be expected to result in impacts on surface water resources, as there are no natural surface water features present at either site. The design and operations of the modified and new facilities would also incorporate appropriate storm-water management controls to safely collect and convey storm water from facilities while minimizing washout and soil erosion. The only liquid effluent associated with these activities consists of sanitary wastewater. No industrial effluent would be discharged to the surface or subsurface at either TA-39 or TA-55. Overall, operations impacts on site surface waters and downstream water quality are expected to be negligible.

Groundwater

Construction Impacts—Groundwater would be required to support construction activities at both TA-39 and TA-55 and would be obtained from the existing potable water lines and trucked to the point of use (LANL 2001a). As shown in Table 5–46, the volume of groundwater required for construction would be minimal compared to site availability, and there would be no onsite discharge of wastewater to the surface or subsurface. Construction dewatering is not expected to be necessary at either TA-39 or TA-55, as all excavation work would occur at a relatively shallow depth, with the proposed new buildings constructed on poured concrete slabs and footings (LANL 2001a). Also, appropriate spill prevention controls, countermeasures, and procedures would be employed to minimize the potential for releases of materials to the surface or subsurface. As a result, no impact on groundwater availability or quality is anticipated from construction activities at either TA-39 or TA-55.

Operations Impacts—Facilities housing relocated SHEBA and other security Category III/IV activities at TA-39 and TA-55, respectively, would use groundwater primarily to meet the potable and sanitary needs of facility support personnel, as well as for miscellaneous building mechanical uses. As shown in Table 5–47, the incremental volume of groundwater required on an annualized basis to support these activities would be negligible compared to site availability. Therefore, no additional impacts on regional groundwater availability are anticipated.

Sanitary wastewater would be generated as a result of facility operations stemming from facility staff use of lavatory facilities, and from miscellaneous potable and sanitary uses. At TA-39, the new control and training building to support SHEBA operations would be served by a new septic tank and leach field (LANL 2001a). Although sanitary effluent would be discharged to the subsurface at TA-39, disposal would be via an approved septic tank and leach field. At TA-55, sanitary wastewater would be collected and conveyed to existing wastewater treatment facilities for ultimate disposal. No industrial effluent would be discharged to the surface or subsurface at either TA-39 or TA-55. Thus, no operations impacts on groundwater quality are expected.

5.6.3.7 Ecological Resources

Terrestrial Resources

Construction Impacts—The relocation of SHEBA and other security Category III/IV activities to TA-39 and TA-55, respectively, is not expected to directly affect terrestrial resources. Indirect impacts (e.g., noise) would be temporary. New water and gas mains required to support the new control and training building would follow roadways and existing utility corridors as much as possible.

Operations Impacts—SHEBA operations and other security Category III/IV activities at TA-39 and TA-55, respectively, would not adversely impact either wildlife or wildlife habitat at either site because relocated activities would not produce emissions or effluent of a quality and level that would adversely affect wildlife.

Wetlands

Construction and Operations Impacts—Construction and operations of new buildings would not directly impact the one wetland located at the eastern end of TA-39 or the three wetlands located within TA-55. Further, storm-water runoff, erosion, and sediment control measures would be undertaken during construction to ensure that indirect impacts would be avoided.

Aquatic Resources

Construction and Operations Impacts—There are no aquatic resources located at either TA-39 or TA-55; thus, direct impacts on these resources would not occur. Indirect impacts on aquatic resources located down-gradient from these areas would be prevented by implementation of appropriate storm-water runoff, erosion, and sediment control measures.

Threatened and Endangered Species

Construction and Operations Impacts—A review of a threatened and endangered species report for the *TA-18 Relocation EIS* concluded that construction and operations associated with SHEBA and security Category III/IV activities at TA-39 and TA-55 may affect, but are not likely to adversely affect, individual Mexican spotted owls or their potential critical habitat. It was further concluded that the proposed action would fall within those actions described as acceptable in the LANL Threatened and Endangered Species Habitat Management Plan. No additional informal or formal consultation by DOE with the U.S. Fish and Wildlife Service is required (LANL 2001a).

5.6.3.8 Cultural and Paleontological Resources

Construction and Operations Impacts—As previously described in the affected environment discussion in Section 5.6.2, archaeological sites have been identified at TA-39 in the vicinity of the two buildings proposed to house the relocated SHEBA operations. Based on current maps of both locations, these sites would be avoided by the proposed action (LANL 2001a). Should Building 6 at TA-39 not be used for the relocation of SHEBA, the new bunker building would be sited away from any archaeological sites to avoid impacting cultural resources. SHEBA operations and the new control and training facilities would not affect any cultural resources at TA-39.

The archaeological site at TA-55, eligible for nomination to the National Register of Historic Places, is located in a fenced area in the vicinity of the proposed location for the security Category III/IV facilities. This archaeological site includes a buffer zone around the site and would be permanently fenced prior to the start of any construction and operations activities in the area. This archaeological site would remain fenced during operations associated with security Category III/IV activities at TA-55 (LANL 2001a).

5.6.3.9 Socioeconomics

Construction Impacts—Construction of new buildings at TA-39 and construction of a laboratory and office building at TA-55 would require a peak construction employment level of 70 workers. This level of employment would generate about 199 indirect jobs in the region around LANL. The potential total employment increase of 269 direct and indirect jobs represents an approximate 0.3 percent increase in the workforce and would occur only over the 18 months of construction. It would have no noticeable impact on the socioeconomic conditions of the region of influence.

Operations Impacts—SHEBA would continue to conduct experiments and tests in all areas. Current levels of employment would continue. No new employment or in-migration of workers would be required. Therefore, there would be no additional impact on the socioeconomic conditions around LANL.

5.6.3.10 Public and Occupational Health and Safety

The assessments of potential radiological impacts associated with relocation of SHEBA activities to LANL's TA-39 are presented in this section. Radiological impacts from relocated security Category III/IV activities at TA-55 would be bounded by the impacts described for the LANL New Facility Alternative in Section 5.2.10. No chemical-related health impacts are associated with any TA-18 operations because only very small quantities of industrial-type chemicals, such as ethanol, isopropyl alcohol, magnesium oxide, phenylphosphine, and xylene, would be used. As stated in the *LANL SWEIS*, the quantities of these chemicals that could be released to the atmosphere during normal operations are minor and would be below the screening levels used to determine the need for additional analysis. There would be no operational increase in the use of these chemicals as a result of the proposed action. No chemicals have been identified that would be a risk to members of the public from construction activities associated with any of the LANL alternatives. Construction workers would be protected from hazardous chemicals by adherence to OSHA and EPA occupational standards that limit concentrations of potentially hazardous chemicals. The potential occupational (industrial) impacts to workers during construction and operations were evaluated based on DOE and Bureau of Labor statistic data and are detailed in Section C.7 of Appendix C. Construction and operations activities under this alternative are expected to result in some injuries but no fatalities to workers for the duration of the proposed action (i.e., about 3 years of construction and 25 years of operations).

Summaries of radiological impacts from normal operations and postulated accidents are presented below. The methodologies used to determine the health effects on the public and facility workers are presented in Appendix B. Supplemental information associated with normal operations and postulated accidents is provided in Appendices B and C, respectively.

Construction and Normal Operations

Construction Impacts—No radiological risks would be incurred by members of the public from relocation or construction activities. Construction workers may be at a small risk. They could receive doses above natural background radiation levels from exposure to radiation from other past or present activities at the site. However, these workers would be protected through appropriate training, monitoring, and management controls. Their exposures would be limited to ensure that doses were kept as low as is reasonably achievable.

Operations Impacts—The only radiological release associated with SHEBA operations at TA-39 would be approximately 100 curies per year of argon-41 to the atmosphere (see Section 5.6.3.3). Trace quantities of other radionuclides may be released during operations involving the handling of security Category III/IV materials. However, health impacts from the releases associated with these activities are expected to be much smaller than those associated with SHEBA operations. Therefore, only the 100-curies-per-year release of argon–41 associated with SHEBA operations has been quantified. The associated calculated impacts on the public are presented in **Table 5–49**. The only dose pathway to the public would be from immersion in the passing plume. To put the doses into perspective, comparisons with natural background radiation levels are included in the table.

As shown in the table, the expected annual radiation dose to the maximally exposed individual member of the public would be much smaller than the limit of 10 millirem per year set by both the EPA (40 CFR 61) and DOE (DOE Order 5400.5) for airborne releases of radioactivity. The risk of a cancer fatality to this individual from operations would be approximately 3.0×10^{-8} per year (i.e., about 1 chance in 30 million per year of a latent cancer fatality). The projected number of fatal cancers for the population within 80 kilometers (50 miles) would be 0.000044 per year (i.e., about 1 chance in 20,000 per year of a latent cancer fatality).

Table 5–49 Annual Radiological Impacts on the Public from SHEBA Operations at TA-39

Receptor	*Impact Values*
Population within 80 Kilometers (50 Miles)	
Collective dose (person-rem)	0.087
Percent of natural background radiation [a]	0.000054
Cancer fatalities [b]	0.000044
Maximally Exposed Offsite Individual	
Dose (millirem)	0.061
Percent of regulatory dose limit [c]	0.61
Percent of natural background radiation [a]	0.017
Cancer fatalities risk [b]	3.1×10^{-8}
Average Individual within 80 Kilometers (50 Miles)	
Dose (millirem)	0.00019
Percent of natural background radiation [a]	0.000054
Cancer fatalities risk [b]	1.0×10^{-10}

[a] The average annual dose from background radiation at LANL is 360 millirem (Section 4.2.11.1); the 450,000 people living within 80 kilometers (50 miles) of the TA-39 site would receive an annual dose of 162,000 person-rem from the background radiation.
[b] Based on a cancer risk estimate of 0.0005 latent cancer fatalities per person-rem (see Appendix B).
[c] This comparison cannot be made for the population and average individual because there is no standard or limit.

Annual radiological doses to workers involved with SHEBA operations at TA-39 are identical to the impacts shown for SHEBA and other security Category III/IV activities under the No Action Alternative, as described in Section 5.2.10.1. As shown in that section, the annual doses to individual workers would be well below the DOE limit of 5,000 millirem (10 CFR 835); the DOE Control Level of 1,000 millirem per year, as established in 10 CFR 835.1002; and the DOE recommended Administrative Control Level of 500 millirem (DOE 1999e). The projected number of fatal cancers in the workforce from operations would be 0.0045 per year (or 1 chance in 220 that the worker population would experience a fatal cancer per year of operations).

Facility Accidents

SHEBA operations would be relocated to new facilities in TA-39. The SHEBA machine would always be aboveground. The radioactive liquid material would remain belowground except for use during an experiment, when it would be pumped to the SHEBA machine. From an accident perspective, the SHEBA machine, associated materials, and equipment are assumed to have the same potential for accidents as at the existing TA-18 location. Certain scenario parameter values applicable to the No Action Alternative, such as leak path factors, materials at risk, and the corresponding source term, have been adjusted to reflect improved safety features of the new facility.

Radiological Impacts—**Table 5–50** shows the frequencies and consequences of the postulated set of accidents for a noninvolved worker and the public (maximally exposed individual and the general population living within 80 kilometers [50 miles] of the facility). **Table 5–51** shows the accident risks, obtained by multiplying the consequences by the likelihood (frequency per year) that an accident would occur. The accidents listed in these tables were selected from a wide spectrum of accidents described in the *TA-18 BIO* (DOE 2001a). The selection process and screening criteria used (as described in Appendix C) ensure that the accidents chosen for evaluation in this EIS bound the impacts of all reasonably foreseeable accidents that could occur at TA-18 facilities. Consideration has also been given to the possibility of an accident at a TA-39 collocated facility that could initiate an accident at the new SHEBA facility. Because of the location of the new SHEBA facility and the distance to any nearby facilities, it was determined that there were no reasonably foreseeable collocated accidents that could affect SHEBA. Thus, in the event that any other accident not evaluated in this EIS were to occur, its impacts on workers and the public would be expected to be within the range of the impacts evaluated.

The accident with the highest risk to the offsite population (see Table 5–51) would be a hydrogen detonation in SHEBA accident. The increased number of latent cancer fatalities in the offsite population would be 4.9×10^{-5} per year (i.e., about 1 chance in 20,000 per year of a latent cancer fatality). The highest risk of a latent cancer fatality to the maximally exposed offsite individual would be 1.4×10^{-7} per year (i.e., about 1 chance in 7 million per year of a latent cancer fatality). The highest risk of a latent cancer fatality to a noninvolved worker located at a prescribed standoff distance of 400 meters (437 yards) from the accident would be 2.0×10^{-6} per year (i.e., about 1 chance in 500,000 per year of a latent cancer fatality).

Table 5–50 Accident Frequency and Consequences from the Relocation of SHEBA

		Maximally Exposed Offsite Individual		*Offsite Population* [a]		*Noninvolved Worker*	
	Frequency (per year)	***Dose (rem)***	***Latent Cancer Fatalities*** [b]	***Dose (person-rem)***	***Latent Cancer Fatalities*** [c]	***Dose (rem)***	***Latent Cancer Fatalities*** [b]
Uncontrolled reactivity insertion in SHEBA in burst mode							
	1.0×10^{-6}	18.0	0.009	6,300	3.54	340	0.27
Hydrogen detonation in SHEBA accident							
	5.4×10^{-3}	0.051	2.5×10^{-5}	18.0	9.0×10^{-3}	0.91	0.00037
Earthquake-induced facility failures without fire accident							
	1.0×10^{-4}	0.32	0.000016	14.3	0.0072	0.57	0.00023
Inadvertent solution criticality in SHEBA accident							
	1.0×10^{-6}	0.00014	7.0×10^{-8}	0.052	2.6×10^{-5}	0.0018	7.2×10^{-7}

[a] Based on a population of 450,302 persons residing within 80 kilometers (50 miles) of the site.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

Table 5–51 Annual Cancer Risks Due to Accidents from the Relocation of SHEBA

Accident	***Maximally Exposed Offsite Individual*** [a]	***Offsite Population*** [b, c]	***Noninvolved Worker*** [a]
Uncontrolled reactivity insertion in SHEBA in burst mode	9.0×10^{-9}	3.5×10^{-6}	2.7×10^{-7}
Hydrogen detonation in SHEBA	1.4×10^{-7}	4.9×10^{-5}	2.0×10^{-6}
Earthquake-induced facility failures without fire	1.6×10^{-9}	7.2×10^{-7}	2.3×10^{-8}
Inadvertent solution criticality in SHEBA	7.0×10^{-14}	2.6×10^{-11}	7.2×10^{-13}

[a] Increased risk of a latent cancer fatality.
[b] Risk of increased number of latent cancer fatalities.
[c] Based on a population of 450,302 persons residing within 80 kilometers (50 miles) of the site.

Hazardous Chemicals and Explosives Impacts—There would be no hazardous chemicals or explosives used or stored at TA-39 associated with SHEBA activities, other than minor industrial quantities, that would impact workers or the public under accident conditions.

Involved Worker Impacts

Approximately 50 workers would be located at the new SHEBA facility. During criticality experiments, workers would be safely located beyond a prescribed distance from the experiments.

Workers in the vicinity of an accident could be at risk of serious injury or fatality. The impacts from the uncontrolled reactivity insertion in SHEBA in a burst-mode accident would be typical of worker impacts during accident conditions.

Facility operating procedures prohibit personnel from being in the test facility during remote operation of SHEBA. If an accident were to occur during a test run due to improper experiment setup and/or a combination of operator errors from the control room, the involved workers would be in the remote-control room and no workers would be present in the test facility. Workers in the remote-control room would be protected by a combination of shielding and distance from the immediate impacts of the accident. The remote-control room engineered safety features and/or protective actions taken by the control-room staff to limit contamination of the control-room environment protects the involved workers.

In the event that workers in the bay area setting up the test were to initiate a criticality accident, it is anticipated these workers would be subject to serious injury or fatality as a result of the accident. Since the facility operating procedures would not prohibit workers from being in adjacent areas during operations, it is anticipated that workers in the vicinity outside of the bay would receive an estimated dose of less than 200 millirem after an uncontrolled criticality event. (This is estimated based on the potential energy released during this accident in relation to that used to design the shielding requirements.)

Following initiation of accident and site emergency alarms, workers would be evacuated from the area in accordance with site emergency operating procedures and would not be vulnerable to additional radiological risk of injury.

5.6.3.11 Environmental Justice

Construction Impacts—There would be no disproportionately high and adverse environmental impacts on minority and low-income populations due to construction if SHEBA and other security Category III/IV activities were relocated to LANL's TA-39 and TA-55, respectively. As stated in other subsections of Section 5.6.3, environmental impacts from construction would be small and would not be expected to extend beyond the LANL site boundary.

Operational Impacts—No disproportionately high and adverse environmental impacts on minority and low-income populations would occur if SHEBA and other security Category III/IV activities were relocated to LANL's TA-39 and TA-55, respectively. This conclusion is a result of analyses presented in this EIS that determined there were no significant impacts on human health, ecological, cultural, paleontological, socioeconomic, and other resource areas described in other subsections of Section 5.6.3.

During normal operations, approximately 100 curies of the noble gas argon-41 could be activated in the atmosphere by SHEBA activities. As a result, impacts measured in terms of latent cancer fatalities on the general population would be small, as indicated in Table 5–49. Additionally, subsistence consumption of crops and wildlife radiologically contaminated with argon-41 would not be harmful, since argon-41 has a half-life of 1 hour and 48 minutes and decays into a stable isotope of potassium that is not harmful to human health in small quantities.

Columns 2 and 3 of Table 5–51 show the radiological risks to the maximally exposed offsite individual and offsite population, respectively, that could result from postulated accidents during SHEBA operations at TA-39. All of these risks are at least four orders of magnitude less than one latent cancer fatality. Hence, none of the postulated accidents would pose a significant radiological risk to the public, including minority and low-income individuals and groups within the population at risk.

5.6.3.12 Waste Management

In accordance with the Records of Decision for the *Waste Management PEIS* (DOE 1997a), waste could be treated and disposed of on site at LANL or at other DOE sites or commercial facilities. Based on the Record of Decision for hazardous waste published on August 5, 1998 (63 FR 41810), nonwastewater hazardous waste will continue to be treated and disposed of at offsite commercial facilities. Based on the Record of Decision for low-level radioactive waste and mixed low-level radioactive waste published on February 18, 2000 (65 FR 10061), minimal treatment of low-level radioactive waste will be performed at all sites, and, to the extent practicable, onsite disposal of low-level radioactive waste will continue. Hanford and NTS will be made available to all DOE sites for disposal of low-level radioactive waste. Mixed low-level radioactive waste analyzed in the *Waste Management PEIS* will be treated at Hanford, INEEL, the Oak Ridge Reservation, and the Savannah River Site and will be disposed of at Hanford and NTS.

It is assumed in this EIS that low-level radioactive waste, mixed low-level radioactive waste, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current and developing site practices. No high-level radioactive or transuranic waste is generated from the operations of SHEBA.

As previously discussed in Section 5.6.2, two locations within TA-39, firing sites 6 and 57, currently operate as open detonation sites for treatment of hazardous waste under RCRA interim status. In addition, approximately 25 potential release sites and 14 solid waste management units, subject to RCRA corrective action standards and the Hazardous and Solid Waste Amendment provisions of LANL's Hazardous Waste Facility Permit, have been identified at TA-39. As a result, any new construction or activity at TA-39 involving these types of solid waste management units would require approval by the New Mexico Environmental Department. Partial or total cleanup of TA-39 may generate substantial quantities of solid and hazardous waste; however, these waste volumes are outside the scope of this EIS. If SHEBA is relocated to Building 6 (firing site 6) at TA-39, the site will require characterization and closure with a potential need for a postclosure permit and associated monitoring. The remediation of TA-39 would be managed under LANL's environmental restoration program and would include appropriate documentation. Therefore, potential waste generated from such remediation activities is not included in the *TA-18 Relocation EIS* analyses.

Construction Impacts—Only hazardous and nonhazardous waste types are expected to be generated from the construction activities associated with relocating SHEBA activities to LANL's TA-39. Only nonhazardous waste is expected to be generated from construction activities associated with relocating security Category III/IV activities to LANL's TA-55. The impacts on the LANL waste management systems, in terms of managing the waste, are discussed in this section. Radiological and chemical impacts on workers and the public from waste management activities are included in the public and occupational health and safety impacts provided in Section 5.6.3.10.

Hazardous waste generated from construction activities to relocate SHEBA to LANL's TA-39 would be decontaminated or recycled to the extent practicable. The remaining waste would be packaged and shipped to offsite RCRA-permitted treatment and disposal facilities. Typically, hazardous waste is not held in long-term storage at LANL. About 450 kilograms (990 pounds) of hazardous waste would be generated from the removal and replacement of an existing transformer in Building 6 at TA-39 (LANL 2001a). This waste represents about 0.05 percent of the annual waste generation rate for the entire LANL site—860,600 kilograms (1,900,000 pounds) per year. The impacts of managing this waste at LANL would be minimal.

Solid nonhazardous waste generated from construction activities to relocate SHEBA and security Category III/IV activities at LANL would be disposed of at the Los Alamos County Landfill located at LANL or its replacement facility within 161 kilometers (100 miles) of LANL after June 30, 2004. Approximately 3.4 cubic meters (4.4 cubic yards) of solid nonhazardous waste would be generated from the construction activities associated with relocating SHEBA activities to LANL's TA-39 (LANL 2001a). This waste represents about 0.06 percent of the current annual solid nonhazardous waste generation rates at LANL (5,453 cubic meters [4,200 cubic yards] per year). The impacts of managing this waste at LANL or off site, would be minimal. Approximately 140 cubic meters (180 cubic yards) of solid nonhazardous waste would be generated from the construction activities associated with relocating security Category III/IV activities to LANL's TA-55 (LANL 2001a). This waste represents about 2.6 percent of the current annual solid nonhazardous waste generation rates at LANL.

Sanitary wastewater generated as a result of construction activities would be managed through the use of portable toilet systems.

Operations Impacts—The impacts of managing waste associated with SHEBA operations and other security Category III/IV activities at LANL would be minimal and are included in the waste generation totals for the LANL New Facility Alternative (see Section 5.2.12) .

5.6.3.13 Transportation

As described in Section 5.2.13 for the TA-18 Upgrade and the LANL New Facility Alternatives, all radioactive material shipments would be conducted within the LANL site. Public risk and accident analyses would not be necessary for the reasons presented in Section 5.2.13. The radiological dose to site workers would include exposure during packaging and loading of radioactive material at TA-18, transport to TA-39, and unloading and unpacking at TA-39. The dose to site workers would be 0.02 person-rem, which corresponds to less than 8×10^{-6} latent cancer fatalities. Dose calculations are described in Appendix D, Section D.7.9.

5.6.3.14 Cumulative Impacts

As discussed in Section 5.2.14, the projected incremental environmental impacts of implementing the proposed action at LANL would not result in additional cumulative impacts. The relocation of SHEBA and other security Category III/IV activities would similarly result in little or no additional cumulative impacts.

5.7 Decontamination and Decommissioning

Decontamination and decommissioning of facilities as a result of the proposed action pertains to two distinct areas: (1) the decontamination and decommissioning of the existing TA-18 facilities if all current missions are relocated, and (2) the decontamination and decommissioning of existing or new relocation facilities at the end of the proposed operations period. At the present time, the ultimate disposition of existing TA-18 facilities, or new facilities constructed to house relocated TA-18 activities, is not known. However, the current condition and contamination history of the existing TA-18 facilities and the projected use of new facilities allows for only a qualitative assessment of the nature and the extent of decontamination required to allow the facilities to be released for unrestricted use.

Decontamination and decommissioning at TA-18 would also involve environmental restoration activities to reduce the long-term public and worker health and safety risks associated with potentially contaminated areas within the site or with surplus facilities and to reduce the risk posed to ecosystems. Decisions regarding whether and how to undertake environmental restoration action would be made after a detailed assessment of the short- and long-term risks and benefits within the framework of RCRA. The approach for controlling the consequences of environmental restoration activities at LANL is summarized in the *LANL SWEIS* (DOE 1999b). Decontamination and decommissioning of TA-18 would involve the general types of activities described and analyzed in the *LANL SWEIS* (e.g., generation of low-level radioactive waste).

Specific alternatives to be considered in the decontamination and decommissioning process would likely follow the RCRA framework and would be subject to project-specific NEPA analysis.

5.7.1 Decommissioning Activities Associated with TA-18 Operations

The major TA-18 operations consist of critical assembly experiments involving radioactive materials and SNM composed of enriched uranium-235 and plutonium-239. The potential residual contamination due to facility operations could result from the release of these materials in the building and to the environment. If the residual radioactivity exceeds the specified criteria for release to unrestricted uses, the facility would have to be decontaminated. From TA-18 operations, the major potential decommissioning activities may involve the following:

- Surface contamination on equipment, walls, roof, floors, sinks, laboratory hoods, air ventilation ducts, etc. The contamination surfaces may be removable or fixed.
- Activated contamination within equipment, metals, building materials, walls, and concrete.
- Solid and liquid contaminated waste from normal operations and off-normal and accident events.
- Land contamination from normal operations and off-normal and accident events.

5.7.2 Level of Contamination Associated with TA-18 Operations

Operational experience with TA-18 critical assembly machines has shown that, although some surface contamination may result from the conduct of specific criticality experiments, the nature and magnitude of this contamination is such that it can be easily removed and reduced to acceptable levels. Surface contamination has been maintained below approximately 5,000 disintegrations per minute per square centimeter after postexperiment decontamination.

In contrast to removable surface contamination, contamination associated with neutron activation of materials around the critical assembly and within the CASA cannot be reduced or eliminated without disposing of the object which contains the activation products. This is due to the fact that activation products are produced throughout the material and not just on its surface. Neutron activation occurs when a stable atom absorbs a neutron, which was emitted from the fission process during a criticality experiment, and becomes a radioactive isotope (radioisotope) of that atom. Many radioisotopes emit relatively harmless types of radiation (e.g., alpha or beta rays), low-energy (i.e., less than 0.5 million electron volts) gamma radiation, or have short half-lives (less than one year), which results in a small radiological hazard to workers and the public during decontamination and decommissioning activities.

In accordance with the Low-Level Radioactive Waste Policy Amendments Act of 1985 (42 U.S.C. 2021b), any radioactive waste generated by TA-18 critical assembly machine operation would be classified as low-level radioactive waste, since it is not high-level radioactive, spent nuclear fuel, or byproduct material as defined by the Atomic Energy Act of 1954.

Previous decontamination and decommissioning experience at nuclear facilities, which involve significant neutron sources, has shown that cobalt-60 is a dominant activation product radioisotope due to the presence of cobalt-59 as an impurity in different steel alloys, its high gamma radiation energy, and its half-life of about 5.3 years. Of the five critical assembly machines at TA-18, only two constitute significant and periodic sources of fission neutrons: Godiva and SHEBA. Experiments with SHEBA have been calculated to result in a larger annual neutron fission source than experiments with Godiva. Using conservative assumptions regarding the magnitude and number of fission experiments conducted with SHEBA and bounding values of cobalt in the stainless steel SHEBA critical assembly vessel (CAV), which houses the fissile material solution for the criticality experiment, a 25-year cobalt-60 activation product volumetric concentration was calculated for the CAV. After 25 years of critical experiments, the SHEBA CAV was calculated to contain approximately 0.01 curies of cobalt-60 per cubic meter, which is much less than the maximum limit of 700 curies per cubic meter for Class A low-level radioactive waste as defined in 10 CFR 61.55 by the U.S. Nuclear Regulatory Commission. This further substantiates that, using the U.S. Nuclear Regulatory Commission criteria, the radioactive activation products from TA-18 critical assembly machines would be only low-level radioactive waste.

Since SHEBA's neutron source bounds all TA-18 machines and the location of the SHEBA CAV represents the closest possible location of any material to fission neutrons, the aforementioned low-level radioactive waste classification of cobalt-60 in the CAV provides technical justification for all materials in and around the critical assembly machines being classified as low-level radioactive waste. Therefore, it is expected that all material in TA-18 or any other location where the TA-18 criticality machines would be relocated would be handled and disposed of as low-level radioactive waste if it has any detectable levels of radiation contamination. The only exception would be the SNM itself. TA-18 critical assembly machines would not generate any high-level radioactive, mixed, or transuranic waste.

5.7.3 Decommissioning Plan

At the end of their use for conducting criticality experiments and related support operations, the TA-18 facilities or the proposed relocation facilities would be subject to the process of decommissioning. The primary decommissioning goal would be for the facility to be decontaminated to the extent that its residual radioactivity is at an acceptable level, thus allowing the land and buildings to be released for unrestricted uses. The facility decontamination would be conducted in a manner to minimize potential impact on health and safety to workers, the general public, and the environment. The facility decontamination would be executed in accordance with the decommissioning plan prepared by the facility operator (a DOE contractor) and approved by DOE.

Prior to the initiation of decommissioning activities, the facility operator would have to prepare a detailed decommissioning plan. The decommissioning plan would contain a detailed description of the site-specific decommissioning activities to be performed and would be sufficient to allow an independent reviewer to assess the appropriateness of the decommissioning activities; the potential impacts on the health and safety of workers, the public, and the environment; and the adequacy of the actions to protect health and safety and the environment. The decommissioning plan would also contain a credible site-specific cost estimate for these actions to allow DOE to allocate adequate funding such that decommissioning activities could be conducted in a timely manner.

5.8 Impacts Common to All Alternatives

As previously stated in Chapter 3, impacts from TA-18 nuclear criticality testing operations would not change, regardless of which relocation alternative were implemented. Testing methods and mission operations would not change and, therefore, would not result in any additional impacts. All alternatives would have the same emissions releases, infrastructure requirements, and would generate the same amount of radioactive and nonradioactive waste from TA-18 operations.

One impact that would be common to all alternatives under the proposed action is the one-time generation of approximately 1.5 cubic meters (2 cubic yards) of low-level radioactive and mixed low-level radioactive waste from the refurbishment of the criticality machines currently housed at TA-18. The radioactive waste would consist of old electrical racks, hydraulic systems, control cartridges, and machine stands that would be replaced by new components as part of TA-18 relocation activities. The refurbishment of these criticality machines would occur under any of the proposed alternatives. This waste represents only 0.05 percent of the annual generation rate of LANL's low-level radioactive and mixed low-level radioactive waste and would be treated, stored, and disposed of in accordance with current and developing site practices. The impact of managing this waste at LANL would be minimal (see Section 4.2.12).

Impacts from the relocation of SHEBA would be common to all relocation alternatives. As discussed in Section 5.6, SHEBA and other security Category III/IV activities would remain at LANL, regardless of the relocation alternative implemented as a result of the Record of Decision for this EIS. The relocation of SHEBA to TA-39 and mission activities involving security Category III/IV SNM would result in impacts on the environment due to construction of new buildings and structures at TA-39 and either a new laboratory and office building at TA-55 under the LANL New Facility Alternative or upgrading of existing security Category III/IV facilities at TA-18 under all other relocation alternatives.

5.9 MITIGATION MEASURES

Construction air quality impacts would be mitigated by implementing standard dust-control practices as required by the state air quality control agency. Particulate matter concentrations along public roads may also be controlled by limiting construction activities to favorable meteorological conditions. Short-term concentrations on public roads from testing of the diesel generators at TA-55, under the LANL New Facility Alternative, would be controlled by appropriate design of the generator stack or other appropriate engineering or management measures. Limitations on testing to favorable meteorological conditions could also be considered by DOE.

5.10 RESOURCE COMMITMENTS

This section describes the unavoidable adverse environmental impacts that could result from the proposed action; the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity; and irreversible and irretrievable commitments of resources. Unavoidable adverse environmental impacts are impacts that would occur after implementation of all feasible mitigation measures. The relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity addresses issues associated with the condition and maintenance of existing environmental resources used to support the proposed action and the utility of these resources after their use. Resources that would be irreversibly and irretrievably committed are those that cannot be recovered or recycled and those that are consumed or reduced to unrecoverable forms.

5.10.1 Unavoidable Adverse Environmental Impacts

Implementing any of the alternatives considered in the EIS for the relocation of TA-18 capabilities and materials at LANL would result in unavoidable adverse impacts on the human environment. In general, these impacts are expected to be minimal and would come from incremental impacts attributed to the operations of either existing or upgraded TA-18 facilities at LANL or new facilities for relocated TA-18 capabilities and materials at SNL/NM, NTS, or ANL-W.

Operations at LANL, SNL/NM, NTS, or ANL-W would result in unavoidable radiation exposure to workers and the general public. Workers would be exposed to direct radiation and other chemicals associated with operating the criticality assembly machines. The incremental annual dose contribution from the research, development, design, construction, and application of experiments on nuclear criticality to the maximally exposed offsite individual, general population, and workers is discussed in Sections 5.2.10, 5.3.10, 5.4.10, and 5.5.10.

Also unavoidable would be the generation of very small amounts of fission products, although there is essentially no radioactive waste from normal operations. Any other waste generated during experiments would be collected at the site, treated and/or stored, and eventually removed for suitable recycling or disposal in accordance with applicable EPA regulations.

Operations of upgraded or new facilities at LANL, SNL/NM, NTS, or ANL-W would have minimal unavoidable adverse impacts on air quality. Air quality would be affected by various chemical or radiological constituents in the routine emissions typical of facility operations at these sites, although criticality experiments held at TA-18 do not release significant emissions to the atmosphere at the site. Impacts on air quality at LANL, SNL/NM, NTS, or ANL-W would occur regardless of TA-18 activities. These routine impacts have been addressed in various other NEPA documentation at these sites. The refurbishment of criticality machines associated with TA-18 missions would generate a one-time minimal amount of low-level radioactive waste material that could affect storage requirements. This would be an unavoidable impact on the amount of available and anticipated storage space and the requirements of disposal facilities at LANL.

Also unavoidable would be the temporary construction impacts associated with the upgrade of existing TA-18 facilities or the construction of new facilities to house TA-18 activities at LANL, SNL/NM, NTS, or ANL-W (i.e., fugitive dust and increased construction vehicle traffic).

5.10.2 Relationship Between Local Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity

Implementation of the alternatives, including the No Action Alternative, would cause short-term commitments of resources and would permanently commit certain resources (e.g., energy). For each alternative, the short-term use of resources would result in potential long-term benefits to the environment and the enhancement of long-term productivity by decreasing overall health risks to workers, the public, and the surrounding environment by reducing their exposure to hazardous and radioactive substances.

Under the No Action Alternative, environmental resources have already been committed to the operations at the current TA-18 facilities. This commitment would serve to maintain existing environmental conditions with little or no impacts on the long-term productivity of the environment.

Under the proposed action, TA-18 operations would not change; therefore, each of the relocation alternatives would exhibit similar relationships between local short-term uses of the environment and the maintenance and enhancement of long-term productivity, with minimal differences in resource commitments. The short-term use of environmental resources at LANL, SNL/NM, NTS, or ANL-W would be greater than for the No Action Alternative. The short-term commitments of resources would include the space and materials required to construct new facilities, the commitment of new operations support facilities, transportation, and other disposal resources and materials for TA-18 operations. Workers, the public, and the environment would be exposed to increased amounts of hazardous and radioactive materials over the short term from the relocation of TA-18 capabilities and materials, including process emissions and the handling of waste from machine refurbishment. Again, these commitments would be offset by an even greater potential for enhanced long-term viability of the environment than under the No Action Alternative.

Regardless of location, air emissions associated with TA-18 operations would introduce small amounts of radiological and nonradiological constituents to the air of the regions around LANL, SNL/NM, NTS, and

ANL-W. Over the 25-year operating period, these emissions would result in additional loading and exposure, but would not impact compliance with air quality or radiation exposure standards at any of these sites. There would be no significant residual environmental effects on long-term environmental viability.

The management and disposal of sanitary solid waste and nonrecyclable radiological waste over the project's life would require a small increase in energy and space at LANL, SNL/NM, NTS, and ANL-W treatment, storage, or disposal facilities or their replacement offsite disposal facilities. Regardless of the location, the land required to meet the solid waste needs would require a long-term commitment of terrestrial resources. Upon the facilities' closures, DOE could decontaminate and decommission the facilities and equipment and restore them to brown-field sites, which could be available for future reuse.

Regardless of location, continued employment, expenditures, and tax revenues generated during the implementation of any of the alternatives would directly benefit the local, regional, and state economies over the short term. Long-term economic productivity could be facilitated by local governments investing project-generated tax revenues into infrastructure and other required services.

The short-term resources to operate TA-18 facilities at either LANL, SNL/NM, NTS, or ANL-W would not affect the long-term productivity of these sites.

5.10.3 Irreversible and Irretrievable Commitments of Resources

Irreversible and irretrievable commitments of resources for each alternative, including the No Action Alternative, potentially would include mineral resources during the life of the project and energy and water used in operating TA-18 facilities. The commitments of capital, energy, labor, and materials during the implementation of the alternatives generally would be irreversible.

Energy expended would be in the form of fuel for equipment and vehicles, electricity for facility operations, and human labor. The energy consumption of facilities to support TA-18 operations would be a small fraction of the total energy used at each DOE site. None of the alternatives evaluated in this EIS would require significantly higher or lower energy consumption. TA-18 operations at any proposed facility would generate nonrecyclable waste steams, such as radiological and nonradiological solid waste and some wastewater. However, certain materials and equipment used during operations of the proposed facilities could be recycled when the facilities are decontaminated and decommissioned.

The implementation of the alternatives considered in this EIS, including the No Action Alternative, would require water, electricity, and diesel fuel. Water at all sites would be obtained from onsite sources. Electricity and diesel fuel would be purchased from commercial sources. These commodities are readily available and the amounts required would not have an appreciable impact on available supplies or capacities. From a material and energy resource commitment perspective, resource requirements would be minimal.

The disposal of hazardous and/or radioactive waste also would cause irreversible and irretrievable commitments of land, mineral, and energy resources. Hazardous waste and low-level radioactive waste disposal would irreversibly and irretrievably commit land for its disposal. For each of the alternatives analyzed in this document, the No Action Alternative would have the least commitment of land, mineral, and energy resources.

CHAPTER 6

Environmental, Occupational Safety and Health Permit, Compliance, and Other Regulatory Requirements

6. ENVIRONMENTAL, OCCUPATIONAL SAFETY AND HEALTH PERMIT, COMPLIANCE, AND OTHER REGULATORY REQUIREMENTS

Chapter 6 presents the laws, regulations, and other requirements that apply to the proposed action and alternatives. Federal environmental, safety, and health laws and regulations are summarized in Section 6.3; Executive orders in Section 6.4; U.S. Department of Energy regulations, orders, and procedures in Section 6.5; and state and local laws and agreements in Section 6.6. Radioactive material packaging and transportation laws and regulations are discussed in Section 6.7. Emergency management and response laws, regulations, and Executive orders are discussed in Section 6.8. Consultations with Federal, state, and local agencies and federally recognized Native American groups are discussed in Section 6.9.

6.1 INTRODUCTION AND PURPOSE

As part of the National Environmental Policy Act (NEPA) process, the environmental impact statement (EIS) must consider whether actions described under its alternatives would result in a violation of any Federal, state, or local law or requirement (40 *Code of Federal Regulations* [CFR]1508.27) or require a permit, license, or other entitlement (40 CFR 1502.25). This chapter provides a baseline summary assessment of the major existing environmental requirements, agreements, and permits that relate to relocation of Technical Area 18 (TA-18).

There are a number of Federal environmental laws that affect environmental protection, health, safety, compliance, and/or consultation at every U.S. Department of Energy (DOE) location. In addition, certain environmental requirements have been delegated to state authorities for enforcement and implementation. Furthermore, state legislatures have adopted laws to protect health and safety and the environment. It is DOE policy to conduct its operations in a manner that ensures the protection of public health, safety, and the environment through compliance with all applicable Federal and state laws, regulations, orders, and other requirements.

The various action alternatives analyzed in this *Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory (TA-18 Relocation EIS)* involve either the operation of existing DOE facilities or the construction and operation of new DOE facilities, and the transportation of materials. Actions required to comply with statutes, regulations, and other Federal and state requirements may depend on whether a facility is newly built (preoperational) or is incorporated in whole or in part into an existing facility. Requirements vary among alternatives located in different states. In this EIS, alternatives are considered in the States of New Mexico, Nevada, and Idaho. Section 3.3 provides a detailed discussion of these alternatives.

6.2 BACKGROUND

Requirements governing the relocation of TA-18 arise primarily from six sources: Congress, Federal agencies, Executive orders, legislatures of the affected states, state agencies, and local governments. In general, the Federal statutes establish national policies, create broad legal requirements, and authorize Federal agencies to create regulations that conform to the statute. Detailed implementation of these statutes is delegated to various Federal agencies such as DOE, the U.S. Department of Transportation (DOT), and the U.S. Environmental Protection Agency (EPA). For many environmental laws under EPA jurisdiction, state agencies may be delegated responsibility for the majority of program implementation activities, such as permitting and enforcement, but EPA usually retains oversight of the delegated program.

Some applicable laws such as NEPA, the Endangered Species Act, and the Emergency Planning and Community Right-To-Know Act require specific reports and/or consultations rather than ongoing permits or activities. These would be satisfied through the legal/regulatory process, including the preparation of the *TA-18 Relocation EIS*, leading to the relocation of TA-18.

Other applicable laws establish general requirements that must be satisfied, but do not include processes (such as the issuance of permits or licenses) to consider compliance prior to specific instances of violations or other events that trigger their provisions. These include the Toxic Substances Control Act (affecting polychlorinated biphenyl transformers and other designated substances); the Federal Insecticide, Fungicide, and Rodenticide Act (affecting pesticide/herbicide applications); the Hazardous Materials Transportation Act; and (if there were to be a spill of a hazardous substance) the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund).

Executive orders establish policies and requirements for Federal agencies. Executive orders are applicable to executive branch agencies, but do not have the force of law or regulation.

In addition to implementing some Federal programs, state legislatures develop their own laws. State statutes supplement as well as implement Federal laws for protection of air and water quality and for groundwater. State legislation may address solid waste management programs, locally rare or endangered species, and local resource, historic, and cultural values. The laws of local governments add a level of protection of the public, often focusing on zoning, utilities, and public health and safety concerns.

Regulatory agreements and compliance orders may also be initiated to establish responsibilities and time frames for Federal facilities to come into compliance with provisions of applicable Federal and state laws. There are also other agreements, memorandums of understanding, or formalized arrangements that establish cooperative relationships and requirements.

The alternatives being considered for the relocation of TA-18 operational capabilities and materials are in the states of New Mexico, Nevada, and Idaho. Each of the alternatives is located on property controlled by DOE. For a broader review of environmental regulations and compliance issues at each site, the reader is referred to recent sitewide or programmatic EISs that include evaluations of activities at those sites.

DOE has authority to regulate some environmental activities, as well as the health and safety aspects of nuclear facilities operations. The Atomic Energy Act of 1954, as amended, is the principal authority for DOE regulatory activities not externally regulated by other Federal or state agencies. Regulation of DOE activities is primarily established through the use of DOE orders and regulations.

External environmental laws, regulations, and executive orders can be categorized as applicable to either broad environmental planning and consultation requirements or regulatory environmental protection and compliance activities, although some requirements are applicable to both planning and operations compliance

Section 6.3 of this chapter discusses the major Federal statutes and regulations that impose nuclear safety and environmental protection requirements on the subject facilities and might require the facilities to obtain a permit or license (or amendment thereof), prior to initiation of the relocation project. Each of the applicable regulations and statutes establishes how activities are to be conducted or how potential releases of pollutants are to be controlled or monitored. These applicable regulations and statutes include requirements for the issuance of permits or licenses for new operations or new emission sources and for amendments to existing permits or licenses to allow new types of operations at existing sources.

Section 6.4 discusses Executive orders. Section 6.5 identifies DOE regulations, orders, and procedures for compliance with the Atomic Energy Act, the Occupational Safety and Health Act, and other environmental, safety, and health matters. Section 6.6 identifies state and local laws, regulations, and ordinances, as well as local agreements potentially affecting the relocation of TA-18. Radioactive material packaging and transportation laws and regulations are discussed in Section 6.7. Section 6.8 discusses emergency management and response laws, regulation, and Executive orders. Consultations with Federal, state, and local agencies and federally recognized Native American groups are discussed in Section 6.9.

6.3 FEDERAL ENVIRONMENTAL, SAFETY, AND HEALTH LAWS AND REGULATIONS

This section describes the Federal environmental, safety, and health laws and regulations that may apply to the proposed action and alternatives.

National Environmental Policy Act of 1969, as amended (42 *United States Code* [U.S.C.] 4321 *et seq.*)—NEPA establishes a national policy promoting awareness of the environmental consequences of human activity on the environment and consideration of environmental impacts during the planning and decision-making stages of a project. It requires Federal agencies to prepare a detailed EIS for any major Federal action with potentially significant environmental impact.

This EIS has been prepared in accordance with NEPA requirements, Council on Environmental Quality regulations (40 CFR 1500 *et seq*.), and DOE (10 CFR 1021, DOE Order 451.1B) provisions for implementing the procedural requirements of NEPA. It discusses reasonable alternatives and their potential environmental consequences.

Atomic Energy Act of 1954 (42 U.S.C. 2011 *et seq.*)—The Atomic Energy Act authorizes DOE to establish standards to protect health or minimize dangers to life or property for activities under DOE's jurisdiction. Through a series of DOE orders, an extensive system of standards and requirements has been established to ensure safe operation of DOE facilities. DOE regulations are found in 10 CFR.

The Atomic Energy Act establishes regulatory control of the disposal of radioactive waste as well as production, possession, and use of three types of radioactive material: source, special nuclear, and byproduct materials. The Atomic Energy Act authorizes DOE to set radiation protection standards for itself and its contractors at DOE nuclear facilities and provides exclusions from U.S. Nuclear Regulatory Commission (NRC) licensing for defense production facilities.

The Atomic Energy Act authorizes DOE to establish standards that protect health and minimize danger to life or property from activities under DOE's jurisdiction. The mechanisms through which DOE manages its facilities are the promulgation of regulations (set forth in 10 CFR 830) and issuance of DOE orders and associated standards and guidance. Requirements for environmental protection, safety, and health are implemented at DOE sites primarily through contractual mechanisms that establish the applicable DOE requirements for management and operating contractors.

Nuclear safety regulations are found in the CFR. Several nuclear safety rules and environmental procedural rules are in effect (for example, 10 CFR 835, "Occupational Radiation Protection"), and more are in final stages of promulgation. Nuclear safety regulations are effective under the schedule and implementing requirements of each rule, regardless of whether they are included in the contract. DOE contractors are also required to comply with all applicable external laws and regulations, regardless of contract language.

Chapter 5 discusses the application of DOE procedures to the management and control of radioactive waste for each alternative. Potential occupational radiation doses and doses to the general public would be well within DOE limits.

Clean Air Act of 1970, as amended (42 U.S.C. 7401 *et seq.*)—The Clean Air Act is intended to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." Section 118 of the Clean Air Act (42 U.S.C. 7418) requires that each Federal agency with jurisdiction over any property or facility engaged in any activity that might result in the discharge of air pollutants comply with "all Federal, state, interstate, and local requirements" with regard to the control and abatement of air pollution.

The Clean Air Act: (1) requires EPA to establish National Ambient Air Quality Standards as necessary to protect the public health, with an adequate margin of safety, from any known or anticipated adverse effects of a regulated pollutant (42 U.S.C. 7409 *et seq.*); (2) requires establishment of national standards of performance for new or modified stationary sources of atmospheric pollutants (42 U.S.C. 7411); (3) requires specific emission increases to be evaluated so as to prevent a significant deterioration in air quality (42 U.S.C. 7470 *et seq.*); and (4) requires specific standards for releases of hazardous air pollutants (including radionuclides) (42 U.S.C. 7412). These standards are implemented through state implementation plans developed by each state with EPA approval. The Clean Air Act requires sources to meet standards and obtain permits to satisfy these standards.

Emissions of air pollutants are regulated by EPA under 40 CFR Parts 50 through 99. Radionuclide emissions from DOE facilities are regulated under the National Emission Standards for Hazardous Air Pollutants Program under 40 CFR 61. Approval to construct a new facility or to modify an existing one may be required by these regulations under 40 CFR 61.07

Chapter 5 compares expected releases at each site with applicable standards. Some releases will result from construction activities at those alternatives requiring construction. During operation, small releases will result during testing of emergency diesel generators and from other sources. At all sites, it was found that the magnitude of the releases would not warrant a Prevention of Significant Deterioration analysis.

Clean Water Act of 1972, as amended (33 U.S.C. 1251 *et seq.*)—The Clean Water Act, which amended the Federal Water Pollution Control Act, was enacted to "restore and maintain the chemical, physical, and biological integrity of the Nation's water." The Clean Water Act prohibits the "discharge of toxic pollutants in toxic amounts" to navigable waters of the United States. Section 313 of the Clean Water Act requires all branches of the Federal Government engaged in any activity that might result in a discharge or runoff of pollutants to surface waters to comply with Federal, state, interstate, and local requirements.

The Clean Water Act provides water quality standards for the Nation's waterways, guidelines and limitations for effluent discharges from point-source discharges, and the National Pollutant Discharge Elimination System (NPDES) permit program. The NPDES program is administered by EPA, pursuant to regulations in 40 CFR 122 *et seq.* Sections 401 through 405 of the Water Quality Act of 1987 added Section 402(p) to the Clean Water Act requiring that EPA establish regulations for permits for storm-water discharges associated with industrial activities. Storm-water provisions of the NPDES program are set forth at 40 CFR 122.26. Permit modifications are required if discharge effluent is altered. Section 404 of the Clean Water Act requires permits for the discharge of dredge or fill materials into navigable waters.

Chapter 4 discusses existing wastewater treatment facilities and the NPDES status at each site. Chapter 5 discusses management of wastewater during construction and operation at each of the alternatives. Sanitary waste would be managed by use of portable toilet facilities during construction. During operation, sanitary wastes would be processed through existing facilities under all of the alternatives. It is anticipated that there would be no discharges requiring a new NPDES permit under any alternative.

Safe Drinking Water Act of 1974, as amended (42 U.S.C. 300(f) *et seq.*)—The primary objective of the Safe Drinking Water Act is to protect the quality of public drinking water supplies and sources of drinking water. The implementing regulations, administered by EPA unless delegated to states, establish standards applicable to public water systems. These regulations include maximum contaminant levels (including those for radioactivity) in public water systems, which are defined as water systems that have at least 15 service connections used by year-round residents or regularly serve at least 25 year-round residents. The EPA regulations implementing the Safe Drinking Water Act are found under 40 CFR 100 through 149. For radioactive material, the regulations specify that the average annual concentration of manmade radionuclides in drinking water, as delivered to the user by such a system, shall not produce a dose equivalent to the total body or an internal organ greater than 4 millirem per year beta activity (40 CFR Section 141.16(a)). Other programs established by the Safe Drinking Water Act include the Sole Source Aquifer Program, the Wellhead Protection Program, and the Underground Injection Control Program.

Chapter 4 discusses groundwater resources and current groundwater protection programs at each site. Chapter 5 discusses protection of groundwater for each alternative. No alternative would involve a direct discharge to the surface or subsurface of sanitary or industrial effluent.

Low-Level Radioactive Waste Policy Act of 1980, as amended (42 U.S.C. 2021 *et seq.*)—This legislation amended the Atomic Energy Act to specify that the Federal Government is responsible for disposal of low-level radioactive waste generated by its activities, and that states are responsible for disposal of other low-level radioactive waste. It provides for and encourages interstate compacts to carry out the state responsibilities.

Low-level radioactive waste is expected to be generated from activities conducted under all of the alternatives.

Chapter 4 discusses existing programs for management of low-level waste at each site. Chapter 5 discusses the volume of low-level radioactive waste and the management of that radioactive waste for each of the alternatives.

Solid Waste Disposal Act of 1965, as amended by the Resource Conservation and Recovery Act of 1976 and the Hazardous and Solid Waste Amendments of 1984 (42 U.S.C. 6901 *et seq.*)—The Solid Waste Disposal Act of 1965, as amended, governs the transportation, treatment, storage, and disposal of hazardous and nonhazardous waste. Under the Resource Conservation and Recovery Act of 1976 (RCRA), which amended the Solid Waste Disposal Act of 1965, EPA defines and identifies hazardous waste; establishes standards for its transportation, treatment, storage, and disposal; and requires permits for persons engaged in hazardous waste activities. Section 3006 of RCRA (42 U.S.C. 6926) allows states to establish and administer these permit programs with EPA approval. The EPA regulations implementing RCRA are found in 40 CFR Parts 260 through 283.

Regulations imposed on a generator or on a treatment, storage, and/or disposal facility vary according to the type and quantity of material or waste generated, treated, stored, and/or disposed. The method of treatment, storage, and/or disposal also impacts the extent and complexity of the requirements.

Chapter 4 provides information on the management of hazardous and mixed radioactive waste for each of the alternative sites. It is anticipated that about 4,000 kilograms of hazardous waste would be generated as a result of operations. Chapter 5 discusses the management of this waste for each of the alternatives.

Federal Facility Compliance Act of 1992 (42 U.S.C. 6961 *et seq.*)—The Federal Facility Compliance Act, enacted on October 6, 1992, amended RCRA. Section 102(a)(3) of the Federal Facility Compliance Act waives sovereign immunity for Federal facilities from fines and penalties for violations of RCRA, state, interstate, and local hazardous and solid waste management requirements. This waiver was delayed for three years following enactment for violations of the land disposal restrictions storage and prohibition (RCRA Section 3004[j]) involving mixed radioactive waste at DOE facilities. This legislation further delays the waiver of sovereign immunity beyond the three-year period at a facility if DOE is in compliance with an approved plan for developing treatment capacity and technologies for mixed radioactive waste generated or stored at the facility, as well as an order requiring compliance with the plan.

Some mixed low-level radioactive waste is expected to be generated from activities conducted for all of the alternatives. The Waste Management sections of Chapter 4 and 5 provide information on the generation and management of mixed radioactive waste and the site specific orders for each of the alternatives.

Pollution Prevention Act of 1990 (42 U.S.C. 13101 *et seq.*)—The Pollution Prevention Act establishes a national policy for waste management and pollution control. Source reduction is given first preference, followed by environmentally safe recycling, with disposal or releases to the environment as a last resort. In response to the policies established by the Pollution Prevention Act, DOE committed to participation in the Superfund Amendments and Reauthorization Act, Section 313, EPA 33/50 Pollution Prevention Program. The goal for facilities involved in compliance with Section 313 is to achieve a 33 percent reduction (from a 1993 baseline) in the release of 17 priority chemicals by 1997. On November 12, 1999, U.S. Secretary of Energy Bill Richardson issued 14 pollution prevention and energy efficiency goals for DOE. These goals were designed to build environmental accountability and stewardship into DOE's decision-making process. Under these goals, DOE will strive to minimize waste and maximize energy efficiency as measured by continuous cost-effective improvements in the use of materials and energy, using the years 2005 and 2010 as interim measurement points.

Radioactive, hazardous, and nonhazardous waste types are expected to be generated from all the alternatives; therefore, efforts must be made to minimize their generation. As discussed in the Waste Management sections of Chapter 4, waste minimization programs are in place at each of the four sites to reduce waste and to recycle where possible.

Toxic Substances Control Act of 1976 (15 U.S.C. 2601 *et seq*.)—The Toxic Substances Control Act provides EPA with the authority to require testing of chemical substances entering the environment and to regulate them as necessary. The law complements and expands existing toxic substance laws such as Section 112 of the Clean Air Act and Section 307 of the Clean Water Act. The Toxic Substances Control Act requires compliance with inventory reporting and chemical control provisions of the legislation to protect the public from the risks of exposure to chemicals. The Toxic Substances Control Act also imposes strict limitations on the use and disposal of polychlorinated biphenyls, chlorofluorocarbons, asbestos, dioxins, certain metal-working fluids, and hexavalent chromium.

Activities under all the alternatives would need to be conducted in compliance with the Toxic Substances Control Act.

Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136 *et seq*.)—This legislation regulates the use, registration, and disposal of several classes of pesticides to ensure that pesticides are applied in a manner that protects the applicators, workers, and the environment. Implementing regulations include recommended procedures for the disposal and storage of pesticides (40 CFR 165 [proposed regulation]) and worker protection standards (40 CFR 170).

Activities under all of the alternatives would need to be conducted in compliance with this act.

National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 *et seq*.)—The National Historic Preservation Act provides that sites with significant national historic value be placed on the *National Register of Historic Places*, which is maintained by the Secretary of the Interior. The major provisions of the act for DOE are Sections 106 and 110. Both sections aim to ensure that historic properties are appropriately considered in planning Federal initiatives and actions. Section 106 is a specific, issue-related mandate to which Federal agencies must adhere. It is a reactive mechanism that is driven by a Federal action. Section 110, in contrast, sets out broad Federal agency responsibilities with respect to historic properties. It is a proactive mechanism with emphasis on ongoing management of historic preservation sites and activities at Federal facilities. No permits or certifications are required under the act.

Section 106 requires the head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking to ensure compliance with the provisions of the act. It compels Federal agencies to "take into account" the effect of their projects on historical and archaeological resources and to give the Advisory Council on Historic Preservation the opportunity to comment on such effects. Section 106 mandates consultation during Federal actions if the undertaking has the potential to affect a historic property. This consultation normally involves the State and/or Tribal Historic Preservation Officers and may include other organizations and individuals such as local governments, Native American tribes, and Native Hawaiian organizations. If an adverse effect is found, the consultation often ends with the execution of a memorandum of agreement that states how the adverse effects will be resolved.

The regulations implementing Section 106, found in 30 CFR 800, were revised on December 12, 2000 (65 FR 77697), and were effective January 11, 2001. This revision modified the process by which Federal agencies consider the effects of their undertakings on historic properties and provides the Advisory Council on Historic Preservation with a reasonable opportunity to comment with regard to such undertakings, as required by Section 106 of the National Historic Preservation Act. In promulgating the new regulations, the Council has sought to better balance the interests and concerns of various users of the Section 106 process, including Federal agencies, State Historic Preservation Officers, Tribal Historic Preservation Officers, Native Americans and Native Hawaiians, industry, and the public.

Chapter 4 describes cultural and paleontological resources at each alternative site. Chapter 5 discusses the potential impacts to those resources of each alternative.

American Antiquities Act of 1906, as amended (16 U.S.C. 431 to 433)—This act protects historic and prehistoric ruins, monuments, and antiquities, including paleontological resources, on federally controlled lands from appropriation, excavation, injury, and destruction without permission.

Chapter 4 describes cultural and paleontological resources at each alternative site. Chapter 5 discusses the potential impacts to those resources of each alternative.

Archaeological and Historic Preservation Act of 1974, as amended (16 U.S.C. 469 to 469c)—This act protects sites that have historic and prehistoric importance.

Chapter 4 describes cultural and paleontological resources at each alternative site. Chapter 5 discusses the potential impacts to those resources of each alternative.

Archaeological and Resources Protection Act of 1979, as amended (16 U.S.C. 470 *et seq.*)—This act requires a permit for any excavation or removal of archaeological resources from Federal or Native American lands. Excavations must be undertaken for the purpose of furthering archaeological knowledge in the public interest, and resources removed remain the property of the United States. The law requires that whenever any Federal agency finds that its activities may cause irreparable loss or destruction of significant scientific, prehistoric, or archaeological data, the agency must notify the U.S. Department of the Interior and may request that the Department undertake the recovery, protection, and preservation of such data. Consent must be obtained from the Native American tribe or the Federal agency having authority over the land on which a resource is located before issuance of a permit; the permit must contain the terms and conditions requested by the tribe or Federal agency.

Chapter 4 describes cultural and paleontological resources at each alternative site. Chapter 5 discusses the potential impacts to those resources of each alternative.

Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.)—The Endangered Species Act is intended to prevent the further decline of endangered and threatened species and to restore these species and their critical habitats. Section 7 of the act requires Federal agencies having reason to believe that a prospective action may affect an endangered or threatened species or its critical habitat to consult with the U.S. Fish and Wildlife Service (USFWS) of the U.S. Department of the Interior or the National Marine Fisheries Service of the U.S. Department of Commerce to ensure that the action does not jeopardize the species or destroy its habitat (50 CFR 17). Despite reasonable and prudent measures to avoid or minimize such impacts, if the species or its habitat would be jeopardized by the action, a formal review process is specified.

Threatened or endangered species in the regions of the four alternatives have been identified and listed for each of the sites in Chapter 4. Chapter 5 discusses the potential impact to these species. At the Nevada Test Site (NTS), there is a potential impact to the desert tortoise. A preconstruction survey immediately prior to construction would be necessary if this site were selected.

Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703 *et seq*.)—The Migratory Bird Treaty Act, as amended, is intended to protect birds that have common migration patterns between the United States and Canada, Mexico, Japan, and Russia. It regulates the harvest of migratory birds by specifying conditions such as the mode of harvest, hunting seasons, and bag limits. The act stipulates that it is unlawful at any time, by any means, or in any manner, to "kill ... any migratory bird." Although no permit for this project is required under the act, DOE is required to consult with the USFWS regarding impacts to migratory birds, and to avoid or minimize these effects in accordance with the USFWS Mitigation Policy. Chapter 4 identifies species known at each alternative site. Chapter 5 discusses impacts to ecological resources for each alternative.

Bald and Golden Eagle Protection Act of 1973, as amended (16 U.S.C. 668 through 668d)—The Bald and Golden Eagle Protection Act, as amended, makes it unlawful to take, pursue, molest, or disturb bald (American) and golden eagles, their nests, or their eggs anywhere in the United States (Section 668, 668c). A permit must be obtained from the U.S. Department of the Interior to relocate a nest that interferes with resource development or recovery operations.

The bald eagle occupies or uses portions of the Los Alamos National Laboratory (LANL) and the Idaho National Engineering and Environmental Laboratory (INEEL). The golden eagle has been sighted at NTS. Chapter 5 discusses the impacts to ecological resources of each alternative.

Fish and Wildlife Coordination Act (16 U.S.C. 661 *et seq*.)—The Fish and Wildlife Coordination Act promotes more effectual planning and cooperation between Federal, state, public, and private agencies for the conservation and rehabilitation of the Nation's fish and wildlife and authorizes the U.S. Department of the Interior to provide assistance. This act requires consultation with the USFWS on the possible effects on wildlife if there is construction, modification, or control of bodies of water in excess of 10 acres in surface area.

Chapter 4 describes the water resources at each of the alternative sites.

Farmland Protection Policy Act of 1981 (7 U.S.C. 4201 *et seq*.)—The Farmland Protection Policy Act requires Federal agencies to consider prime or unique farmlands when planning major projects and programs on Federal lands. Federal agencies are required to use prime and unique farmland criteria developed by the U.S. Department of Agriculture's Soil Conservation Service. Under the Farmland Protection Policy Act, the Soil Conservation Service is authorized to maintain an inventory of prime and unique farmlands in the United States to identify the location and extent of rural lands important in the production of food, fiber, forage, and oilseed crops (7 CFR 657).

Chapter 4 identifies agricultural activities at each alternative site. No cultivated farming is reported.

American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996)—This act reaffirms Native American religious freedom under the First Amendment and sets U.S. policy to protect and preserve the inherent and constitutional right of Native Americans to believe, express, and exercise their traditional religions. The act requires that Federal actions avoid interfering with access to sacred locations and traditional resources that are integral to the practice of religions.

Chapter 4 describes Traditional Cultural Properties resources known to exist at each site. Chapter 5 discusses the potential impacts to Traditional Cultural Properties resources of each alternative.

Religious Freedom Restoration Act of 1993 (42 U.S.C. 2000(bb) *et seq*.)—This act prohibits the U.S. Government, including Federal departments, from substantially burdening the exercise of religion unless the Government demonstrates a compelling governmental interest, the action furthers a compelling government interest, and it is the least restrictive means of furthering that interest.

Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001)—This act establishes a means for Native Americans to request the return or repatriation of human remains and other cultural items presently held by Federal agencies or federally assisted museums or institutions. The act also contains provisions regarding the intentional excavation and removal of, inadvertent discovery of, and illegal trafficking in Native American human remains and cultural items. Major actions under this law include (a) establishing a review committee with monitoring and policymaking responsibilities; (b) developing regulations for repatriation, including procedures for identifying lineal descent or cultural affiliation needed for claims; (c) providing oversight of museum programs designed to meet the inventory requirements and deadlines of this law; and (d) developing procedures to handle unexpected discoveries of graves or grave goods during activities on Federal or tribal lands. All Federal agencies that manage land and/or are responsible for archaeological collections obtained from their lands or generated by their activities must comply with the act. DOE managers of ground-disturbing activities on Federal and tribal lands should make themselves aware of the statutory provisions treating inadvertent discoveries of Native American remains and cultural objects. Regulations implementing the act are found at 43 CFR 10.

Chapter 4 describes Native American resources known to exist at each site. Chapter 5 discusses the potential impacts to Native American resources of each alternative.

Occupational Safety and Health Act of 1970 (29 U.S.C. 651 *et seq.*)—The Occupational Safety and Health Act establishes standards for safe and healthful working conditions in places of employment throughout the United States. The act is administered and enforced by the Occupational Safety and Health Administration

(OSHA), a U.S. Department of Labor agency. Although OSHA and EPA both have a mandate to reduce exposures to toxic substances, OSHA's jurisdiction is limited to safety and health conditions that exist in the workplace environment.

Under the act, it is the duty of each employer to provide a workplace that is free of recognized hazards that are likely to cause death or serious physical harm. Employees have a duty to comply with the occupational safety and health standards and rules, regulations, and orders issued under the act. OSHA regulations (29 CFR 1910) establish specific standards telling employers what must be done to achieve a safe and healthful working environment. Government agencies, including DOE, are not technically subject to OSHA regulations, but are required under 29 U.S.C. 668 to establish their own occupational safety and health programs for their places of employment consistent with OSHA standards. DOE emphasizes compliance with these regulations at its facilities and prescribes, through DOE orders, the OSHA standards that contractors shall meet, as applicable to their work at government-owned, contractor-operated facilities (DOE Order 440.1A). DOE keeps and makes available the various records of minor illnesses, injuries, and work-related deaths as required by OSHA regulations.

Activities under all the alternatives would be conducted in compliance with this act.

Noise Control Act of 1972, as amended (42 U.S.C. 4901 *et seq*.)—Section 4 of the Noise Control Act of 1972, as amended, directs all Federal agencies to carry out "to the fullest extent within their authority" programs within their jurisdictions in a manner that furthers a national policy of promoting an environment free from noise jeopardizing health and welfare.

DOE programs to promote control of noise at each of the four alternative sites are discussed in Chapter 4. Chapter 5 discusses the potential noise impact of each of the alternatives.

6.4 Environmental, Safety, and Health Executive Orders

Executive Order 11514 (Protection and Enhancement of Environmental Quality, March 5, 1970)—This order (regulated by 40 CFR 1500 through 1508) requires Federal agencies to continually monitor and control their activities to (1) protect and enhance the quality of the environment and (2) develop procedures to ensure the fullest practicable provision of timely public information and understanding of the Federal plans and programs that may have potential environmental impacts so that the views of interested parties can be obtained. DOE has issued regulations (10 CFR 1021) and DOE Order 451.1B for compliance with this Executive order.

As previously discussed in Section 6.3, this EIS has been prepared in accordance with NEPA requirements (i.e., 40 CFR 1500 through 1508, 10 CFR 1021, and DOE Order 451.1B).

Executive Order 11593 (National Historic Preservation, May 13, 1971)—This order directs Federal agencies to locate, inventory, and nominate qualified properties under their jurisdiction or control to the *National Register of Historic Places*. This process requires DOE to provide the Advisory Council on Historic Preservation the opportunity to comment on the possible impacts of the proposed activity on any potential eligible or listed resources.

Chapter 4 identifies historic resources at each of the alternative sites. Chapter 5 discusses potential impacts to historic resources at each site.

Executive Order 11988 (Floodplain Management, May 24, 1977)—This order (regulated by 10 CFR 1022) requires Federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for any action undertaken in a floodplain, and that floodplain impacts be avoided to the extent practicable.

Chapter 4 identifies the delineated floodplains at each of the alternative sites.

Executive Order 11990 (Protection of Wetlands, May 24, 1977)—This order (regulated by 10 CFR 1022) requires Federal agencies to avoid any short- or long-term adverse impacts on wetlands wherever there is a practicable alternative.

Chapter 4 identifies the wetlands at each alternative site. Chapter 5 discusses the measures to be taken to protect wetlands where applicable.

Executive Order 12088 (Federal Compliance with Pollution Control Standards, October 13, 1978, as amended by Executive Order 12580, Federal Compliance with Pollution Control Standards, January 23, 1987)—This order directs Federal agencies to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the Clean Air Act, the Noise Control Act, the Clean Water Act, the Safe Drinking Water Act, the Toxic Substances Control Act, and RCRA.

Activities under all of the alternatives would need to be conducted to comply with this order.

Executive Order 12580 (Superfund Implementation, August 28, 1996)—This order delegates to the heads of Executive departments and agencies the responsibility of undertaking remedial actions for releases or threatened releases that are not on the National Priorities List and for removal actions, other than emergencies, where the release is from any facility under the jurisdiction or control of Executive departments and agencies.

Activities under all of the alternatives would need to be conducted in compliance with this order.

Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, February 11, 1994)—This order requires each Federal agency to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations.

The Environmental Justice sections of Chapters 4 and 5 and Appendix B of this EIS provide information that demonstrates compliance with this order.

Executive Order 13007 (Indian Sacred Sites, May 24, 1996)—This order requires: "In managing Federal lands, each executive branch agency with statutory or administrative responsibility for the management of Federal lands shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies shall maintain the confidentiality of sites."

Chapter 4 identifies Native American resources at each alternative site. Chapter 5 discusses the potential impacts to Native American resources. A cultural resource survey will be done at the selected site prior to any construction activity.

Executive Order 13101 (Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition, September 14, 1998)—This order requires each Federal agency to incorporate waste prevention and recycling in its daily operations and to work to increase and expand markets for recovered materials. This order states that it is national policy to prefer pollution prevention, whenever feasible. Pollution that cannot be prevented should be recycled; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner. Disposal should be employed only as a last resort.

Activities under all of the alternatives would need to be conducted to comply with this order.

Executive Order 13112 (Invasive Species, February 3, 1999)—This order requires Federal agencies to prevent the introduction of invasive species to provide for their control, and to minimize their economic, ecological, and human health impacts.

Activities under all of the alternatives would need to be conducted to comply with this order.

Executive Order 13123 (Greening the Government Through Efficient Energy Management, June 3, 1999)—This order directs Federal agencies to improve energy management in order to save taxpayer dollars and reduce emissions that contribute to air pollution and global climate change.

Activities under all of the alternatives would need to be conducted to comply with this order.

Executive Order 13148 (Greening the Government Through Leadership in Environmental Management, April 21, 2000)—This order sets new goals for pollution prevention, requires all Federal facilities to have an environmental management system, and requires compliance or environmental management system audits.

Activities under all of the alternatives would need to be conducted to comply with this order.

6.5 DOE Environmental, Safety, and Health Regulations and Orders

The Atomic Energy Act authorizes DOE to establish standards to protect health and/or minimize the dangers to life or property from activities under DOE's jurisdiction. Through a series of DOE orders and regulations, an extensive system of standards and requirements has been established to ensure safe operation of DOE facilities.

DOE regulations are found in 10 CFR. These regulations address such areas as energy conservation, administrative requirements and procedures, nuclear safety, and classified information. For the purpose of this EIS, relevant regulations include: "Procedural Rules for DOE Nuclear Activities" (10 CFR 820), "Nuclear Safety Management" (10 CFR 830), "Occupational Radiation Protection" (10 CFR 835), "Compliance with the National Environmental Policy Act" (10 CFR 1021), and "Compliance with Floodplains/Wetlands Environmental Review Requirements" (10 CFR 1022).

DOE orders are issued in support of environmental, safety, and health programs. Many DOE orders have been revised and reorganized to reduce duplication and eliminate obsolete provisions. The new DOE order organization is organized by series, with each number identified by three digits, and is intended to include all DOE orders, policies, manuals, requirement documents, notices, and guides. The remaining DOE orders, which are identified by four digits, are expected to be revised and converted to the new DOE numbering system. The major DOE orders pertaining to the alternatives are listed in **Table 6–1**.

Table 6–1 Relevant DOE Orders (as of June 5, 2001)

DOE Order	*Subject*
Leadership/Management/Planning	
O 151.1A	Comprehensive Emergency Management System (11/01/00)
Information and Analysis	
O 231.1	Environment, Safety, and Health Reporting (09/30/95; Change 2, 11/07/96)
O 232.1A	Occurrence Reporting and Processing of Operations Information (07/21/97)
Work Process	
O 414.1A	Quality Assurance (09/29/99)
O 420.1	Facility Safety (10/13/95; Change 3, 11/22/00)
O 430.1A	Life Cycle Asset Management (10/14/98)
O 435.1	Radioactive Waste Management (07/09/99)
O 440.1A	Worker Protection Management for DOE Federal and Contractor Employees (03/27/98)
O 451.1B	National Environmental Policy Act Compliance Program (10/26/00)
O 460.1A	Packaging and Transportation Safety (10/02/96)
O 460.2	Departmental Materials Transportation and Packaging Management (09/27/95; Change 1, 10/26/95)
O 461.1	Packaging and Transfer or Transportation of Materials of National Security Interest (09/29/00)
O 470.1	Safeguards and Security Program (09/28/95; Change 1, 06/21/96)
O 470.2A	Security and Emergency Management Independent Oversight and Performance Assurance Program (03/01/00)
O 473.2	Protective Force Program (06/30/00)
O 474.1A	Control and Accountability of Nuclear Materials (11/20/00)
External Relationships	
1230.2	American Indian Tribal Government Policy (04/08/92)
Personnel Relations and Services	
3790.1B	Federal Employee Occupational Safety and Health Program (01/07/93)
Real Property Management	
4330.4B	Maintenance Management Program (02/10/94)
Project Management	
4700.1	Project Management System (03/06/87; Change 1, 06/02/92)
Environmental Quality and Impact	
5400.1	General Environmental Protection Program (11/09/88; Change 1, 06/29/90)
5400.5	Radiation Protection of the Public and the Environment (02/08/90; Change 2, 01/07/93)
5480.4	Environmental Protection, Safety, and Health Protection Standards (05/15/84; Change 4, 01/07/93)
5480.19	Conduct of Operations Requirements for DOE Facilities (07/09/90); Change 1, (05/18/92)
5480.20A	Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities (11/15/94)
5480.21	Unreviewed Safety Questions (12/24/91)
5480.22	Technical Safety Requirements (02/25/92; Change 2, 01/23/96)
5480.23	Nuclear Safety Analysis Reports (04/10/92; Change 1, 03/10/94)
5480.30	Nuclear Reactor Safety Design Criteria (01/19/93; Change 1, 03/14/01)

DOE Order	*Subject*
Emergency Preparedness	
5530.3	Radiological Assistance Program (01/14/92; Change 1, 04/10/92)
5530.5	Federal Radiological Monitoring and Assessment Center (07/10/92; Change 1, 12/02/92)
Defense Programs	
5632.1C	Protection and Control of Safeguards and Security Interests (07/15/94)
5660.1B	Management of Nuclear Materials (05/26/94)
Design, Construction, and Engineering	
6430.1A	General Design Criteria (04/06/89)

6.6 STATE ENVIRONMENTAL LAWS, REGULATIONS, AND AGREEMENTS

Certain environmental requirements, including some discussed in Section 6.3, have been delegated to state authorities for implementation and enforcement. It is DOE policy to conduct its operations in an environmentally safe manner that complies with all applicable laws, regulations, and standards, including state laws and regulations. A list of applicable state laws, regulations, and agreements is provided in **Table 6–2**. This list is not exhaustive and other state laws and regulations may be applicable.

Table 6–2 State Environmental Laws, Regulations, and Agreements

Law/Regulation/Agreement	*Citation*	*Requirements*
	Argonne National Laboratory-West, Idaho	
Idaho Environmental Protection and Health Act	Idaho Code (IC), Title 39, Health and Safety, Chapter 1, Department of Health and Welfare, Sections 39-105	Provides for development of air pollution control permitting regulations.
Rules for the Control of Air Pollution in Idaho	Idaho Administrative Procedure Act (IDAPA) 58, Department of Environmental Quality, Title 1, Chapter 1 (58.01.01)	Enforces national ambient air quality standards.
Idaho Water Pollution Control Act	IC, Title 39, Chapter 36, Water Quality	Establishes a program to enhance and preserve the quality and value of water resources.
Water Quality Standards and Wastewater Treatment Requirements	IDAPA 58.01.02	Establishes water quality standards and wastewater treatment requirements.
Idaho Rules for Public Drinking Water Systems	IDAPA 58, Department of Health and Welfare, 58.01.08	Controls and regulates the design, construction, operation, maintenance, and quality control of public drinking water.
Transportation of Hazardous Waste	IC, Title 18, Crimes and Punishment, Chapter 39, Highways and Bridges, Section 18-3905; IC, Title 49, Motor Vehicles, Chapter 22, Hazardous Materials/Hazardous Waste Transportation Enforcement	Regulates transportation of hazardous materials/hazardous waste on highways.
Idaho Hazardous Waste Management Act	IC, Title 39, Chapter 44, Hazardous Waste Management	Requires permit prior to construction or modification of a hazardous waste disposal facility.
Rules and Standards for Hazardous Waste	IDAPA 58.01.05	Requires permit prior to construction or modification of a hazardous waste disposal facility.

Law/Regulation/Agreement	***Citation***	***Requirements***
Various Acts Regarding Fish and Game	IC, Title 36, Fish and Game, Chapters 9, Protection of Fish, 11, Protection of Animals and Birds, and 24, Species Conservation	Requires consultation with responsible agency.
Endangered Species Act	IC, Title 67, State Government and State Affairs, Chapter 8, Executive and Administrative Officers, Section 67-818	Requires consultation with Department of Fish and Game.
Rules for Classification and Protection of Wildlife	IDAPA 13, Department of Fish and Game, 13.01.06	Requires consultation with Department of Fish and Game.
Idaho Historic Preservation Act	IC, Title 67, Chapter 46, Preservation of Historic Sites	Requires consultation with responsible local governing body.
Agreement in Principle (Formerly Tribal Working Agreement)	September 27, 2000	Establishes understanding and commitment between the tribes and DOE.
Spent Fuel Settlement Agreement (also known as the Governor's Agreement)	October 17, 1995	Allows INEEL to receive spent nuclear fuel and mixed radioactive waste from off site and establishes schedules for the treatment of existing high-level radioactive waste, transuranic waste, and mixed radioactive waste, and the removal of spent nuclear fuel from the state. (This agreement is not applicable to the alternative because only new waste will be generated by the proposed action. This newly generated waste, if determined to be mixed radioactive waste, will be covered by the INEEL Site Treatment Plan.)
Consent Order for Federal Facility Compliance Plan	November 1, 1995 (Issued to INEEL and Argonne National Laboratory-West [ANL-W])	Addresses compliance with the Federal Facility Compliance Act and mixed radioactive waste treatment issues by implementing the INEEL Site Treatment Plan.
Los Alamos and Sandia National Laboratories, New Mexico		
New Mexico Air Quality Control Act	New Mexico Statutes Annotated (NMSA), Chapter 74, Environmental Improvement, Article 2, Air Pollution, and Implementing Regulations at New Mexico Administrative Code (NMAC) Title 20, Environmental Protection, Chapter 2, Air Quality	Establishes air quality standards and requires a permit prior to construction or modification of an air contaminant source. Also requires an operating permit for major producers of air pollutants and imposes emission standards for hazardous air pollutants.
New Mexico Radiation Protection Act	NMSA, Chapter 74, Article 3, Radiation Control	Establishes state requirements for worker protection.
New Mexico Water Quality Act	NMSA, Chapter 74, Article 6, Water Quality; Implementing Regulations found in NMAC, Title 20, Chapter 6, Water Quality	Establishes water quality standards and requires a permit prior to the construction or modification of a water discharge source.
New Mexico Groundwater Protection Act	NMSA, Chapter 74, Article 6B, Groundwater Protection	Establishes state standards for protection of groundwater from leaking underground storage tanks.
New Mexico Solid Waste Act	NMSA, Chapter 74, Article 9, Solid Waste Act; Implementing Regulations found in NMAC Title 20, Environmental Protection, Chapter 9, Solid Waste	Requires permit prior to construction or modification of a solid waste disposal facility.

Law/Regulation/Agreement	***Citation***	***Requirements***
New Mexico Hazardous Waste Act	NMSA, Chapter 74, Article 4, Hazardous Waste, and Implementing Regulations at NMAC Title 20, Environmental Protection, Chapter 4, Hazardous Waste	Requires a permit prior to construction or modification of a hazardous waste disposal facility.
New Mexico Hazardous Chemicals Information Act	NMSA, Chapter 74, Article 4E-1, Hazardous Chemicals Information	Implements the hazardous chemical information and toxic release reporting requirements of the Emergency Planning and Community Right-to-Know Act of 1986 (SARA Title III) for covered facilities.
New Mexico Wildlife Conservation Act	NMSA, Chapter 17, Game and Fish, Article 2, Hunting and Fishing Regulations, Part 3, Wildlife Conservation Act	Requires permit and coordination if a project may disturb habitat or otherwise affect threatened or endangered species.
New Mexico Raptor Protection Act	NMSA, Chapter 17, Article 2-14	Makes it unlawful to take, attempt to take, possess, trap, ensnare, injure, maim, or destroy any of the species of hawks, owls, and vultures.
New Mexico Endangered Plant Species Act	NMSA, Chapter 75, Miscellaneous Natural Resource Matters, Article 6, Endangered Plants	Requires coordination with the state.
Threatened and Endangered Species of New Mexico	NMAC, Title 19, Natural Resources and Wildlife, Chapter 33, Endangered and Threatened Species, 19.33.6.8	Establishes the list of threatened and endangered species.
Endangered Plant Species	NMAC, Title 19, Chapter 21, Endangered Plants	Establishes plant species list and rules for collection.
New Mexico Cultural Properties Act	NMSA, Chapter 18, Libraries and Museums, Article 6, Cultural Properties	Establishes State Historic Preservation Office and requirements to prepare an archaeological and historic survey and consult with the State Historic Preservation Office.
Environmental Oversight and Monitoring Agreement	Agreement in Principle Between DOE and the State of New Mexico, October 1, 1995	Provides DOE support for state activities in environmental oversight, monitoring, access, and emergency response.
Pueblo Accords	DOE 1992 Cooperative Agreements with each of four Pueblos	Sets forth the relationship between DOE and the Pueblos.
Los Alamos County Noise Restrictions	Los Alamos County Code, Chapter 8.28	Imposes noise restrictions and makes provisions for exceedances.
City of Albuquerque Noise Control Ordinance	Ordinance 21-1975	Establishes acceptable noise levels for various activities within the City of Albuquerque.
Federal Facility Compliance Order	October 1995 (Issued to both DOE and LANL)	Requires compliance with the site treatment plan which documents the development of treatment capacities and technologies or use of offsite facilities for treating mixed radioactive waste.
Federal Facility Compliance Order	October 6, 1995 (Issued to Sandia National Laboratories/New Mexico [SNL/NM])	Requires compliance with the site treatment plan for the treatment of mixed radioactive waste at SNL/NM.

Law/Regulation/Agreement	***Citation***	***Requirements***
Nevada Test Site, Nevada		
Nevada Air Pollution Control Law	Nevada Revised Statutes (NRS), Title 40, Public Health and Safety, Chapter 445B, Air Pollution	Requires permit prior to construction or modification of an air contaminant source.
Nevada Air Quality Regulations	Nevada Administrative Code (NAC), Chapter 445B, Air Controls, Air Pollution	Implements both state and Federal (EPA) clean air statutes. Identifies permit and monitoring requirements.
Nevada Water Pollution Control Law	NRS Title 40, Chapter 445A, Water Controls	Requires permit prior to construction or modification of a water discharge source.
Nevada Water Pollution Control Regulations	NAC, Chapter 445A, Sections 070-348, Water Pollution Control	Classifies waters of the state, establishes standards for water quality, and specifies discharge permit requirements and notification requirements.
Nevada Water Quality Standards	NAC, Chapter 445A, Water Controls	Establishes water quality standards. Requires permit prior to discharge to surfacewaters or groundwaters of the state.
Nevada Drinking Water Regulations	NAC, Chapter 445A, Water Controls	Sets standards for drinking water specifications for certification and control of variances and exemptions. Sets standards for wells and other water supply systems. Establishes regulation of wells, aquifer exemptions, prohibited wells, operation, monitoring, etc., as well as plugging and abandonment activities.
Nevada Solid Waste Disposal Law	NRS, Title 40, Chapter 444, Sanitation	Requires permit prior to construction or modification of a solid waste disposal facility.
Nevada Solid Waste Regulations	NAC, Chapter 444, Sanitation, Sections 570-749, Solid Waste Disposal	Sets forth definitions, methods of disposal, and special requirements for hazardous waste collection and transportation standards and classification of landfills.
Nevada Hazardous Waste Regulations	NAC, Chapter 444, Sanitation, Sections 842-874, Facilities for Management of Hazardous Waste	Establishes fees, variances, restrictions, and permits. Adopts 40 CFR 2, 124, and 260 to 270, inclusive as a part of the Nevada Administrative Code.
Nevada Sewage Disposal Regulations	NAC, Chapter 444, Sanitation, Sections 750-840, Sewage Disposal	Establishes standards, regulations, permits, and requirements for septic tanks and other sewage disposal systems for dwellings, communities, and commercial buildings.

Law/Regulation/Agreement	***Citation***	***Requirements***
Nevada Public Waters Law	NRS, Title 48, Water Chapter 533, Adjudication of Vested Water Rights; Appropriation of Public Waters	Sets forth requirements, procedures, and a process for acquiring a permit for appropriation of public waters. Establishes permit fees and sets forth environmental requirements. Note that the Legislative Counsel Bureau, Carson City, has not published a corresponding chapter in the Nevada Administrative Code covering the implementation of Nevada Revised Statutes, Chapter 533.
Nevada Underground Water, Wells, and Related Drilling Requirements	NAC, Chapter 534, Underground Water and Wells, Sections 280-298, License to Drill Well and Sections 300-450, Drilling, Construction, and Plugging of Wells	Establishes ownership of underground waters and their appropriation for beneficial use. Specifies the conditions, requirements, and rules for acquiring such water. Sets forth license requirements for well drillers; requirements of drilling, construction, and plugging of wells; and protection of aquifers from pollution and waste.
Protection of Indigenous Flora	NRS Title 47, Forestry; Forestry Products and Flora, Chapter 527, Protection and Preservation of Timbered Lands, Trees, and Flora	Provides protection of indigenous flora. Plants declared to be threatened with extinction are placed on the state list of fully protected species.
Nevada Wildlife Regulations	NAC, Chapter 503, Hunting, Fishing, and Trapping; Miscellaneous Protective Measures, Sections 010-104, General Provisions	Specifies classification of wildlife as protected and unprotected.
Nevada Historic Preservation and Archaeology Law	NRS, Title 33, Libraries, Museums; Historic Preservation, Chapter 383, Historic Preservation and Archaeology	Requires permit prior to the investigation, exploration, or excavation of a historic or prehistoric site.
Mutual Consent Agreement between State of Nevada and DOE for the Storage of the Low-Level Land Disposal Restricted Mixed Radioactive Waste	Transmitted from P. Liebendorfer (NDEP) to D. Elle (DOE/Nevada), 1995	Provides a nine-month period to prepare and submit a plan for the treatment and disposal of newly generated mixed low-level radioactive waste not covered under the Site Treatment Plan. Allows available storage capacity of the transuranic waste pad to be used for storage of onsite-generated mixed low-level radioactive waste that does not meet RCRA land disposal restriction provisions.
Agreement in Principle between DOE and the State of Nevada	June 1999	Provides funding to Nevada for oversight of DOE's environmental, safety, and health activities.
U.S. District Court of Nevada jurisdiction for the Death Valley Groundwater Flow System	U.S. v. Cappaert *et al.*, 375 F. Supp. 456 (D. Nevada 1974)	Maintains an adequate water supply while ensuring protection of the surrounding ecosystem.

6.7 Radioactive Material Packaging and Transportation Regulations

Transportation of hazardous and radioactive materials and substances is governed by DOT and NRC. The Hazardous Material Transportation Act of 1975 (49 U.S.C. 5105 *et seq*.) requires DOT to prescribe uniform national regulations for transportation of hazardous materials (including radioactive materials). Most state and local regulations regarding such transportation that are not substantively the same as DOT regulations are preempted (i.e., rendered void) (49 U.S.C. 5125). This in effect allows state and local governments only to enforce the Federal regulations, not to change or expand upon them.

This program is administered by the DOT Research and Special Programs Administration, which coordinates its regulations with those of NRC (under the Atomic Energy Act) and EPA (under RCRA) when covering the same activities.

DOT regulations, which may be found under 49 CFR 171 through 178, and 49 CFR 383 through 397, contain requirements for identifying a material as hazardous or radioactive. These regulations interface with the NRC regulations for identifying material, but DOT hazardous material regulations govern the hazard communication (e.g., marking, hazard labeling, vehicle placarding, emergency response telephone number) and shipping requirements.

The NRC regulations applicable to radioactive materials transportation may be found under 10 CFR 71. These regulations include detailed packaging design and package certification testing requirements. Complete documentation of design and safety analysis and the results of the required testing are submitted to NRC to certify the package for use. This certification testing involves the following components: heat, physical drop onto an unyielding surface, water submersion, puncture by dropping the package onto a steel bar, and gas tightness.

The transportation casks used to transport radioactive material are subject to numerous inspections and tests (10 CFR 71.87). These tests are designed to ensure that cask components are properly assembled and meet applicable safety requirements. Tests and inspections are clearly identified in the Safety Analysis Report for Packaging and/or the Certificate of Compliance for each cask. Casks are loaded and inspected by registered users in compliance with approved quality assurance programs. Operations involving the casks are conducted in compliance with 10 CFR 71.91. Reports of defects or accidental mishandling are submitted to NRC.

Chapter 5 discusses the potential transportation impacts of each alternative.

6.8 Emergency Management and Response Laws, Regulations, and Executive Orders

This section discusses the laws, regulations, and Executive orders that address the protection of public health and worker safety and require the establishment of emergency plans. These laws, regulations, and Executive orders relate to the operation of facilities, including DOE facilities that engage directly or indirectly in the production of special nuclear material.

6.8.1 Emergency Management and Response Federal Laws

Emergency Planning and Community Right-to-Know Act of 1986 (U.S.C. 11001 *et seq.*) (also known as "SARA Title III")—This act requires emergency planning and notice to communities and government agencies concerning the presence and release of specific chemicals. EPA implements this act under regulations found in 40 CFR 355, 370, and 372. Under Subtitle A of this act, Federal facilities are required to provide various information (such as inventories of specific chemicals used or stored and releases that occur from these sites) to the state emergency response commission and to the local emergency planning committee to ensure that emergency plans are sufficient to respond to unplanned releases of hazardous substances. Implementation of the provisions of this act began voluntarily in 1987, and inventory and annual emissions reporting began in 1988. DOE requires compliance with Title III as a matter of DOE policy at its contractor-operated facilities.

Chapter 4 describes emergency planning for each alternative site. Each alternative site is at an existing, operating DOE facility. Each DOE site has established an emergency management program that would be activated in the event of an accident. The programs have been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management plan includes emergency planning, training, preparedness, and response.

Chapter 5 discusses the impacts of potential accidents for each alternative.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. 9604(I) (also know as "Superfund")—This act provides authority for Federal and state governments to respond directly to hazardous substance incidents. The act requires reporting of spills, including radioactive spills, to the National Response Center.

It will be necessary to comply with this requirement for any alternative.

Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 (42 U.S.C. 5121)—This act, as amended, provides an orderly, continuing means of providing Federal Government assistance to state and local governments in managing their responsibilities to alleviate suffering and damage resulting from disasters. The President, in response to a state governor's request, may declare an "emergency" or "major disaster" to provide Federal assistance under this act. The President, in Executive Order 12148, delegated all functions except those in Sections 301, 401, and 409 to the Director of the Federal Emergency Management Agency. The act provides for the appointment of a Federal coordinating officer who will operate in the designated area with a state coordinating officer for the purpose of coordinating state and local disaster assistance efforts with those of the Federal Government.

Justice Assistance Act of 1984 (42 U.S.C. 3701-3799)—This act establishes Emergency Federal Law Enforcement Assistance, which provides assistance to state and local governments in responding to a law enforcement emergency. The act defines the term "law enforcement emergency" as an uncommon situation which requires law enforcement, which is or threatens to become of serious or epidemic proportions, and with respect to which state and local resources are inadequate to protect the lives and property of citizens or to enforce the criminal law. Emergencies that are not of an ongoing or chronic nature (for example, the Mount Saint Helens volcanic eruption) are eligible for Federal law enforcement assistance including funds, equipment, training, intelligence information, and personnel.

Price-Anderson Act (42 U.S.C. 2210)—This act allows DOE to indemnify its contractors if the contract involves the risk of public liability from a nuclear incident.

6.8.2 Emergency Management and Response Federal Regulations

Quantities of Radioactive Materials Requiring Consideration of the Need for an Emergency Plan for Responding to a Release (10 CFR 30.72, Schedule C)—This section of the regulations provides a list that is the basis for both the public and private sector to determine whether the radiological materials they handle must have an emergency response plan for unscheduled releases, and is one of the threshold criteria documents for DOE hazards assessments required by DOE Order 5500.3A, "Planning and Preparedness for Operational Emergencies." The "Federal Radiological Emergency Response Plan," dated November 1995, primarily discusses offsite Federal response in support of state and local governments with jurisdiction during a peacetime radiological emergency.

Chapter 4 describes emergency preparedness for each alternative.

Occupational Safety and Health Administration Emergency Response, Hazardous Waste Operations, and Worker Right to Know (29 CFR 1910)—This regulation establishes OSHA requirements for employee safety in a variety of working environments. It addresses employee emergency and fire prevention plans (Section 1910.38), hazardous waste operations and emergency response (Section 1920.120), and hazards communication (Section 1910.1200) to make employees aware of the dangers they face from hazardous materials at their workplace. These regulations do not directly apply to Federal agencies. However, Section 19 of the Occupational Safety and Health Act (29 U.S.C. 668) requires all Federal agencies to have occupational safety programs "consistent" with Occupational Safety and Health Act standards.

Chapter 4 describes DOE emergency programs.

Emergency Management and Assistance (44 CFR Section 1.1)—This regulation contains the policies and procedures for the Federal Emergency Management Act, National Flood Insurance Program, Federal Crime Insurance Program, Fire Prevention and Control Program, Disaster Assistance Program, and Preparedness Program, including radiological planning and preparedness.

Hazardous Materials Tables and Communications, Emergency Response Information Requirements (49 CFR 172)—This regulation defines the regulatory requirements for marking, labeling, placarding, and documenting hazardous material shipments. The regulation also specifies the requirements for providing hazardous material information and training.

Chapter 5 discusses transportation impacts for each alternative.

6.8.3 Emergency Response and Management Executive Orders

Executive Order 12148 (Federal Emergency Management, July 20, 1979)—This order transfers functions and responsibilities associated with Federal emergency management to the Director of the Federal Emergency Management Agency. The order assigns the director the responsibility to establish Federal policies for, and to coordinate all civil defense and civil emergency planning, management, mitigation, and assistance functions of, Executive agencies.

Executive Order 12656 (Assignment of Emergency Preparedness Responsibilities, November 18, 1988)—This order assigns emergency preparedness responsibilities to Federal departments and agencies.

Executive Order 12938 (Proliferation of Weapons of Mass Destruction, November 14, 1994)—This order states that the proliferation of nuclear, biological, and chemical weapons ("weapons of mass destruction") and the means of delivering such weapons constitutes an unusual and extraordinary threat to the national security, foreign policy, and economy of the United States, and that a national emergency would be declared to deal with that threat.

6.9 CONSULTATIONS WITH FEDERAL, STATE, AND LOCAL AGENCIES AND FEDERALLY RECOGNIZED NATIVE AMERICAN GROUPS

Certain laws, such as the Endangered Species Act, the Fish and Wildlife Coordination Act, and the National Historic Preservation Act, require consultation and coordination by DOE with other governmental entities including other Federal agencies, state and local agencies, and federally recognized Native American groups. These consultations must occur on a timely basis and are generally required before any land disturbance can begin. Most of these consultations are related to biotic resources, cultural resources, and Native American rights.

The biotic resource consultations generally pertain to the potential for activities to disturb sensitive species or habitats. Cultural resource consultations relate to the potential for disruption of important cultural resources and archaeological sites. Native American consultations are concerned with the potential for disturbance of ancestral Native American sites and the traditional practices of Native Americans.

Los Alamos National Laboratory

With respect to biotic resources, DOE has determined that the proposed action would fall within those actions described as acceptable in the *Los Alamos National Laboratory Threatened and Endangered Species Habitat Management Plan* (LANL 1998) and, therefore, no additional informal or formal consultation by DOE is necessary to comply with the provisions of 50 CFR 402, Interagency Cooperation - Endangered Species Act of 1973, as amended.

With respect to cultural resources, LANL is performing a historic building eligibility assessment of the buildings in TA-18, some of which are 50 years old. The buildings are being evaluated for adverse effects, and the evaluation will be sent to the State Historic Preservation Office and Advisory Council on Historic Preservation for concurrence. After the Record of Decision is issued on this EIS, DOE will work with these organizations and the public to develop the resolution of adverse effects and a Memorandum of Agreement.

Sandia National Laboratories/New Mexico

SNL/NM is not conducting consultations with Federal, state, and local agencies and federally recognized Native American groups because the proposed activity will occur on previously disturbed land. No threatened and endangered, prehistoric, historic, cultural, or Native American sites of interest are found within TA-V.

Nevada Test Site

A sitewide biological opinion for activities conducted at NTS exists to protect threatened and endangered species at the site. Surveys would be conducted at the proposed location for new facilities at the Device Assembly Facility for cultural and biological resources prior to any construction. No consultation with Federal, state, and local agencies and federally recognized Native American groups would occur prior to the completion of these surveys.

Argonne National Laboratory-West

Consultations with Federal, state, and local agencies and federally recognized Native American groups are being conducted for the proposed action at ANL-W. With respect to biotic resources, consultation has been completed with the USFWS Snake River Basin Office in Idaho regarding the proposed relocation of TA-18 capabilities and materials from LANL to ANL-W in Butte County, Idaho. The USFWS provided DOE with a list of endangered, threatened, proposed, and/or candidate species which may be present in the area of

ANL-W. This list fulfills the requirements for a species list under Section 7(c) of the Endangered Species Act of 1973, as amended (USFWS 2001). In addition, the Idaho Fish and Game Upper Snake Region Office, in a letter to DOE dated May 18, 2001, stated that their office has no fish and wildlife concerns with the proposed action at ANL-W (Idaho Fish & Game 2001).

CHAPTER 7

References

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CHAPTER 8

Glossary

TA-18

8. GLOSSARY

absorbed dose — For ionizing radiation, the energy imparted to matter by ionizing radiation per unit mass of the irradiated material (e.g., biological tissue). The units of absorbed dose are the rad and the gray. (See *rad* and *gray*.)

accident sequence — In regard to nuclear facilities, an initiating event followed by system failures or operator errors, which can result in significant core damage, confinement system failure, and/or radionuclide releases.

actinide — Any member of the group of elements with atomic numbers from 89 (actinium) to 103 (lawrencium) including uranium and plutonium. All members of this group are radioactive.

activation products — Nuclei, usually radioactive, formed by bombardment and absorption in material with neutrons, protons, or other nuclear particles.

active fault — A fault that is likely to have another earthquake sometime in the future. Faults are commonly considered to be active if they have moved one or more times in the last 10,000 years.

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

administrative control level — A dose level that is established well below the regulatory limit to administratively control and help reduce individual and collective radiation doses. Facility management should establish an annual facility administrative control level that should, to the extent feasible, be more restrictive than the more general administrative control level.

air pollutant — Generally, an airborne substance that could, in high-enough concentrations, harm living things or cause damage to materials. From a regulatory perspective, an air pollutant is a substance for which emissions or atmospheric concentrations are regulated or for which maximum guideline levels have been established due to potential harmful effects on human health and welfare.

air quality control region — Geographic subdivisions of the United States, designed to deal with pollution on a regional or local level. Some regions span more than one state.

alluvium (alluvial) — Unconsolidated, poorly sorted detrital sediments ranging from clay to gravel sizes deposited by streams.

alpha activity — The emission of alpha particles by radioactive materials.

alpha particle — A positively charged particle ejected spontaneously from the nuclei of some radioactive elements. It is identical to a helium nucleus and has a mass number of 4 and an electrostatic charge of +2. It has low penetrating power and a short range (a few centimeters in air). (See *alpha radiation*.)

***alpha radiation* —** A strongly ionizing, but weakly penetrating, form of radiation consisting of positively charged alpha particles emitted spontaneously from the nuclei of certain elements during radioactive decay. Alpha radiation is the least penetrating of the three common types of ionizing radiation (alpha, beta, and gamma). Even the most energetic alpha particle generally fails to penetrate the dead layers of cells covering the skin and can be easily stopped by a sheet of paper. Alpha radiation is most hazardous when an alpha-emitting source resides inside an organism. (See *alpha particle*.)

***ambient* —** Surrounding.

***ambient air* —** The surrounding atmosphere as it exists around people, plants, and structures.

***ambient air quality standards* —** The level of pollutants in the air prescribed by regulations that may not be exceeded during a specified time in a defined area. Air quality standards are used to provide a measure of the health-related and visual characteristics of the air.

***aquatic* —** Living or growing in, on, or near water.

***aquifer* —** An underground geologic formation, group of formations, or part of a formation capable of yielding a significant amount of water to wells or springs.

***aquitard* —** A less-permeable geologic unit that inhibits the flow of water.

***archaeological sites (resources)* —** Any location where humans have altered the terrain or discarded artifacts during either prehistoric or historic times.

***argon-41* —** A radioactive argon isotope with a half-life of 1.83 hours that emits beta particles and gamma radiation. It is formed by the activation, by neutron absorption, of argon-40, a stable argon isotope present in small quantities in air.

***artifact* —** An object produced or shaped by human workmanship of archaeological or historical interest.

***as low as is reasonably achievable (ALARA)* —** An approach to radiation protection to manage and control worker and public exposures (both individual and collective) and releases of radioactive material to the environment to as far below applicable limits as social, technical, economic, practical, and public policy considerations permit. ALARA is not a dose limit but a process for minimizing doses to as far below limits as is practicable.

***atmospheric dispersion* —** The process of air pollutants being dispersed in the atmosphere. This occurs by wind that carries the pollutants away from their source, by turbulent air motion that results from solar heating of the Earth's surface, and by air movement over rough terrain and surfaces.

***Atomic Energy Commission* —** A five-member commission, established by the Atomic Energy Act of 1946, to supervise nuclear weapons design, development, manufacturing, maintenance, modification, and dismantlement. In 1974, the Atomic Energy Commission was abolished, and all functions were transferred to the U.S. Nuclear Regulatory Commission and the Administrator of the Energy Research and Development Administration. The Energy Research and Development Administration was later terminated, and functions vested by law in the Administrator were transferred to the Secretary of Energy.

***atomic number* —** The number of positively charged protons in the nucleus of an atom or the number of electrons on an electrically neutral atom.

attainment area — An area that the U.S. Environmental Protection Agency has designated as being in compliance with one or more of the National Ambient Air Quality Standards for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants but not for others. (See *National Ambient Air Quality Standards*, *nonattainment area*, and *particulate matter*.)

attractiveness level — A categorization of nuclear material types and compositions that reflects the relative ease of processing and handling required to convert that material to a nuclear explosive device.

background radiation — Radiation from (1) cosmic sources; (2) naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material); (3) global fallout as it exists in the environment (e.g., from the testing of nuclear explosive devices); (4) air travel; (5) consumer and industrial products; and (6) diagnostic x-rays and nuclear medicine.

badged worker — A worker equipped with an individual dosimeter who has the potential to be exposed to radiation.

barrier — Any material or structure that prevents or substantially delays movement of radionuclides toward the accessible environment.

basalt — The most common volcanic rock, dark gray to black in color, high in iron and magnesium, and low in silica. It is typically found in lava flows.

baseline — The existing environmental conditions against which impacts of the proposed action and its alternatives can be compared. For this EIS, the environmental baseline is the site environmental conditions as they exist or are estimated to exist in the absence of the proposed action.

becquerel — A unit of radioactivity equal to one disintegration per second. Thirty-seven billion becquerels equal 1 curie.

BEIR V — Biological Effects of Ionizing Radiation; referring to the fifth in a series of committee reports from the National Research Council.

beryllium — An extremely lightweight element with the atomic number 4. It is metallic and is used in reactors as a neutron reflector.

best available control technology (BACT) — A term used in the Federal Clean Air Act that means the most stringent level of air pollutant control considering economics for a specific type of source based on demonstrated technology.

beta emitter — A radioactive substance that decays by releasing a beta particle.

beta particle — A particle emitted in the radioactive decay of many radionuclides. A beta particle is identical to an electron. It has a short range in air and a small ability to penetrate other materials.

beyond-design-basis accident — An accident postulated for the purpose of generating large consequences by exceeding the functional and performance requirements for safety structures, systems, and components. (See *design-basis accident*.)

***beyond-design-basis events* —** Postulated disturbances in process variables due to external events or multiple component or system failures that can potentially lead to beyond-design-basis accidents. (See *design-basis events*.)

***biota (biotic)* —** The plant and animal life of a region (pertaining to biota).

***block* —** U.S. Bureau of the Census term describing small areas bounded on all sides by visible features or political boundaries; used in tabulation of census data.

***bounded* —** Producing the greatest consequences of any assessment of impacts associated with normal or abnormal operations.

***burial ground* —** In regard to radioactive waste, a place for burying unwanted (i.e., radioactive) materials in which the earth acts as a receptacle to prevent the escape of radiation and the dispersion of waste into the environment.

***Cambrian* —** The earliest geologic time period of the Paleozoic era, spanning between about 570 and 505 million years ago.

***cancer* —** The name given to a group of diseases characterized by uncontrolled cellular growth, with cells having invasive characteristics such that the disease can transfer from one organ to another.

***canister* —** A general term for a container, usually cylindrical, used in handling, storage, transportation, or disposal of waste.

***capable fault* —** A fault that has exhibited one or more of the following characteristics: (1) movement at or near the ground surface at least once within the past 35,000 years, or movement of a recurring nature within the past 500,000 years; (2) macroseismicity instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the fault; (3) a structural relationship to a capable fault according to characteristic (1) or (2) above, such that movement on one could reasonably be expected to be accompanied by movement on the other.

***capacity factor* —** The ratio of the annual average power production of a power plant to its rated capacity.

***carbon dioxide* —** A colorless, odorless gas that is a normal component of ambient air; it results from fossil fuel combustion and is an expiration product.

***carbon monoxide* —** A colorless, odorless, poisonous gas produced by incomplete fossil fuel combustion.

***carcinogen* —** An agent that may cause cancer. Ionizing radiations are physical carcinogens; there are also chemical and biological carcinogens and biological carcinogens may be external (e.g., viruses) or internal (genetic defects).

***CASA (Critical Assembly Storage Area)* —** In this *TA-18 Relocation EIS*, one of the remote-controlled critical assembly buildings associated with the Los Alamos Critical Experiments Facility.

***cask* —** A heavily shielded container used to store or ship radioactive materials.

categories of special nuclear material (Categories I, II, III, and IV) — A designation determined by the quantity and type of special nuclear material or a designation of a special nuclear material location based on the type and form of the material and the amount of nuclear material present. A designation of the significance of special nuclear material based upon the material type, the form of the material, and the amount of material present in an item, grouping of items, or in a location.

cation — A positively charged ion.

cell — See *hot cell*.

chain reaction — A reaction that initiates its own repetition. In nuclear fission, a chain reaction occurs when a neutron induces a nucleus to fission and the fissioning nucleus releases one or more neutrons, which induce other nuclei to fission.

cladding — The outer metal jacket of a nuclear fuel element or target. It prevents fuel corrosion and retains fission products during reactor operation and subsequent storage, as well as providing structural support. Zirconium alloys, stainless steel, and aluminum are common cladding materials. In general, a metal coating bonded onto another metal.

Class I areas — A specifically designated area where the degradation of air quality is stringently restricted (e.g., many national parks and wilderness areas). (See *Prevention of Significant Deterioration*.)

Class II areas — Most of the country not designated as Class I is designated as Class II. Class II areas are generally cleaner than air quality standards require, and moderate increases in new pollution are allowed after a regulatory-mandated impacts review.

classified information — (1) information that has been determined pursuant to Executive Order 12958, any successor order, or the Atomic Energy Act of 1954 (42 U.S.C. 2011) to require protection against unauthorized disclosure; (2) certain information requiring protection against unauthorized disclosure in the interest of national defense and security or foreign relations of the United States pursuant to Federal statute or Executive order.

clastic — Refers to rock or sediment made up primarily of broken fragments of preexisting rocks or minerals.

collective dose — The sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation. Collective dose is expressed in units of person-rem or person-sieverts.

colluvium (colluvial) — A loose deposit of rock debris accumulated at the base of a cliff or slope.

Comet — A general-purpose critical assembly machine designed to accommodate a wide variety of experiments in which neutron multiplication must be measured as a function of distance between components. Currently located at the TA-18 facilities, subject to relocation.

committed dose equivalent — The dose equivalent to organs or tissues that will be received by an individual during the 50-year period following the intake of radioactive material. It does not include contributions from external radiation sources. Committed dose equivalent is expressed in units of rem or sieverts.

***committed effective dose equivalent* —** The dose value obtained by (1) multiplying the committed dose equivalents for the organs or tissues that are irradiated and the weighting factors applicable to those organs or tissues, and (2) summing all the resulting products. Committed effective dose equivalent is expressed in units of rem or sieverts. (See *committed dose equivalent* and *weighting factor*.)

***community (biotic)* —** All plants and animals occupying a specific area under relatively similar conditions.

***community (environmental justice)* —** A group of people or a site within a spatial scope exposed to risks that potentially threaten health, ecology, or land values or are exposed to industry that stimulates unwanted noise, smell, industrial traffic, particulate matter, or other nonaesthetic impacts.

***Comprehensive Test Ban Treaty (CTBT)* —** A proposed treaty prohibiting nuclear tests of all magnitudes.

***computational modeling* —** Use of a computer to develop a mathematical model of a complex system or process and to provide conditions for testing it.

***conformity* —** Conformity is defined in the Clean Air Act as the action's compliance with an implementation plan's purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards, expeditious attainment of such standards, and that such activities will not: (1) cause or contribute to any new violation of any standard in any area; (2) increase the frequency or severity of any existing violation of any standard in any area; or (3) delay timely attainment of any standard, required interim emission reduction, or other milestones in any area.

***contact-handled waste* —** Radioactive waste or waste packages whose external dose rate is low enough to permit contact handling by humans during normal waste management activities (e.g., waste with a surface dose rate not greater than 200 millirem per hour). (See *remote-handled waste*.)

***container* —** In regard to radioactive waste, the metal envelope in the waste package that provides the primary containment function of the waste package, which is designed to meet the containment requirements of 10 CFR 60.

***contamination* —** The deposition of undesirable radioactive material on the surfaces of structures, areas, objects, or personnel.

***cooperating agency* —** Any Federal agency other than a lead agency which has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or a reasonable alternative) for legislation or other major Federal action significantly affecting the quality of the human environment.

***credible accident* —** An accident that has a probability of occurrence greater than or equal to once in a one-million-year time period.

***Cretaceous* —** The final geologic time period of the Mesozoic era, spanning between about 144 and 66 million years ago. The end of this period also marks the end of dinosaur life on Earth.

***criteria pollutants* —** Six air pollutants for which the National Ambient Air Quality Standards are established by the U.S. Environmental Protection Agency under Title I of the Federal Clean Air Act: sulfur dioxide, nitrogen oxides, carbon monoxide, ozone, lead, and two size classes of particulate matter, less than or equal to 10 micrometers (0.0004 inch) in diameter, and less than or equal to 2.5 micrometers (0.0001 inch) in diameter. New pollutants may be added to, or removed from, the list of criteria pollutants as more information becomes available.

critical assembly — A critical assembly is a system of fissile material (uranium-233, uranium-235, plutonium-239, or plutonium-241) with or without a moderator in a specific proportion and shape. The critical assembly can be gradually built up by adding additional fissile material and/or moderator until this system achieves the dimensions necessary for a criticality condition. A continuous neutron source is placed at the center of this assembly to measure the fission rate of the critical assembly as it approaches and reaches criticality.

critical habitat — Defined in the Endangered Species Act of 1973 as "specific areas within the geographical area occupied by [an endangered or threatened] species..., essential to the conservation of the species and which may require special management considerations or protection; and specific areas outside the geographical area occupied by the species...that are essential for the conservation of the species."

critical mass — The smallest mass of fissionable material that will support a self-sustaining nuclear fission chain reaction.

criticality — The condition in which a system is capable of sustaining a nuclear fission chain reaction.

cultural resources — Archaeological sites, historical sites, architectural features, traditional use areas, and Native American sacred sites.

cumulative impacts — The impacts on the environment that result from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions, regardless of the agency or person who undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

curie — A unit of radioactivity equal to 37 billion disintegrations per second (i.e., 37 billion becquerels); also a quantity of any radionuclide or mixture of radionuclides having 1 curie of radioactivity.

day-night average sound level — The 24-hour, A-weighted equivalent sound level expressed in decibels. A 10-decibel penalty is added to sound levels between 10:00 p.m. and 7:00 a.m. to account for increased annoyance due to noise during night hours.

decay (radioactive) — The decrease in the amount of any radioactive material with the passage of time, due to spontaneous nuclear disintegration (i.e., emission from atomic nuclei of charged particles, photons, or both).

decibel (dB) — A unit for expressing the relative intensity of sounds on a logarithmic scale where 0 is below human perception and 130 is above the threshold of pain to humans. For traffic and industrial noise measurements, the A-weighted decibel, a frequency-weighted noise unit, is widely used. The A-weighted decibel scale corresponds approximately to the frequency response of the human ear and thus correlates well with loudness.

decibel, A-weighted (dBA) — A unit of frequency-weighted sound pressure level, measured by the use of a metering characteristic and the "A" weighting specified by the American National Standards Institution (ANSI S1.4-1983 [R1594]) that accounts for the frequency response of the human ear.

decommissioning — Retirement of a facility, including any necessary decontamination and/or dismantlement.

***decontamination* —** The actions taken to reduce or remove substances that pose a substantial present or potential hazard to human health or the environment, such as radioactive or chemical contamination from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

***defense-in-depth* —** The use of multiple, independent protection elements combined in a layered manner so that the system capabilities do not depend on a single component to maintain effective protection against defined threats.

***°C (degrees Celsius)* —** A unit for measuring temperature using the centigrade scale in which the freezing point of water is 0 degrees and the boiling point is 100 degrees.

***°F (degrees Fahrenheit)* —** A unit for measuring temperature using the Fahrenheit scale in which the freezing point of water is 32 degrees and the boiling point is 212 degrees.

***delayed critical devices* —** A critical assembly designed to reach the condition of delayed supercriticality. Delayed criticality is the nuclear physics supercriticality condition, where the neutron multiplication factor of the assembly is between 1 (critical) and 1 plus the delayed neutron fraction. (See *multiplication factor* and *delayed neutrons.*)

***delayed neutrons* —** Neutrons emitted from fission products by beta decay following fission by intervals of seconds to minutes. Delayed neutrons account for approximately 0.2 to 0.7 percent of all fission neutrons. For uranium-235, the delayed neutron fraction is about 0.007; for plutonium-239, it is about 0.002.

***depleted uranium* —** Uranium whose content of the fissile isotope uranium-235 is less than the 0.7 percent (by weight) found in natural uranium, so that it contains more uranium-238 than natural uranium.

***deposition* —** In geology, the laying down of potential rock-forming materials; sedimentation. In atmospheric transport, the settling out on ground and building surfaces of atmospheric aerosols and particles ("dry deposition"), or their removal from the air to the ground by precipitation ("wet deposition" or "rainout").

***design basis* —** For nuclear facilities, information that identifies the specific functions to be performed by a structure, system, or component, and the specific values (or ranges of values) chosen for controlling parameters for reference bounds for design. These values may be: (1) restraints derived from generally accepted state-of-the-art practices for achieving functional goals; (2) requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which a structure, system, or component must meet its functional goals; or (3) requirements derived from Federal safety objectives, principles, goals, or requirements.

***design-basis accident* —** An accident postulated for the purpose of establishing functional and performance requirements for safety structures, systems, and components.

***design-basis events* —** Postulated disturbances in process variables that can potentially lead to design-basis accidents.

***design-basis threat* —** The elements of a threat postulated for the purpose of establishing requirements for safeguards and security programs, systems, components, equipment, information, or material (See *threat*.)

***dewatering* —** The removal of water. Saturated soils are “dewatered” to make construction of building foundations easier.

direct economic effects — The initial increases in output from different sectors of the economy resulting from some new activity within a predefined geographic region.

direct jobs — The number of workers required at a site to implement an alternative.

diversion — The unauthorized removal of nuclear material from its approved use or authorized location.

dolostone — A carbonate rock made up predominately of the mineral dolomite, $CaMg(C0_3)_2$.

dose — A generic term that means absorbed dose, effective dose equivalent, committed effective dose equivalent, or total effective dose equivalent, as defined elsewhere in this glossary. It is a measure of the energy imparted to matter by ionizing radiation. The unit of dose is the rem or rad.

dose equivalent — A measure of radiological dose that correlates with biological effect on a common scale for all types of ionizing radiation. Defined as a quantity equal to the absorbed dose in tissue multiplied by a quality factor (the biological effectiveness of a given type of radiation) and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert.

dose rate — The radiation dose delivered per unit of time (e.g., rem per year).

dosimeter — A small device (instrument) carried by a radiation worker that measures cumulative radiation dose (e.g., a film badge or ionization chamber).

drinking water standards — The level of constituents or characteristics in a drinking water supply specified in regulations under the Safe Drinking Water Act as the maximum permissible.

ecology — A branch of science dealing with the interrelationships of living organisms with one another and with their nonliving environment.

ecosystem — A community of organisms and their physical environment interacting as an ecological unit.

effective dose equivalent — The dose value obtained by multiplying the dose equivalents received by specified tissues or organs of the body by the appropriate weighting factors applicable to the tissues or organs irradiated, and then summing all of the resulting products. It includes the dose from internal and external radiation sources. The effective dose equivalent is expressed in units of rem or sieverts. (See *committed dose equivalent* and *committed effective dose equivalent*.)

effluent — A gas or fluid discharged into the environment.

electron — An elementary particle with a mass of 9.107×10^{-28} gram (or 1/1,837 of a proton) and a negative charge. Electrons surround the positively charged nucleus and determine the chemical properties of the atom.

emission — A material discharged into the atmosphere from a source operation or activity.

emission standards — Legally enforceable limits on the quantities and/or kinds of air contaminants that can be emitted into the atmosphere.

endangered species — Defined in the Endangered Species Act of 1973 as "any species which is in danger of extinction throughout all or a significant portion of its range."

engineered safety features — For a nuclear facility, features that prevent, limit, or mitigate the release of radioactive material from its primary containment.

enriched uranium — Uranium whose content of the fissile isotope uranium-235 is greater than the 0.7 percent (by weight) found in natural uranium. (See *uranium, natural uranium,* and *highly enriched uranium.*)

Environment, Safety, and Health Program — In the context of DOE, encompasses those requirements, activities, and functions in the conduct of all DOE and DOE-controlled operations that are concerned with: impacts on the biosphere; compliance with environmental laws, regulations, and standards controlling air, water, and soil pollution; limiting the risks to the well-being of both the operating personnel and the general public; and protecting property against accidental loss and damage. Typical activities and functions related to this program include, but are not limited to, environmental protection, occupational safety, fire protection, industrial hygiene, health physics, occupational medicine, process and facility safety, nuclear safety, emergency preparedness, quality assurance, and radioactive and hazardous waste management.

environmental impact statement (EIS) — The detailed written statement required by Section 102(2)(C) of the National Environmental Policy Act for a proposed major Federal action significantly affecting the quality of the human environment. A DOE EIS is prepared in accordance with applicable requirements of the Council on Environmental Quality National Environmental Policy Act regulations in 40 CFR 1500–1508 and the DOE National Environmental Policy Act regulations in 10 CFR 1021. The statement includes, among other information, discussions of the environmental impacts of the proposed action and all reasonable alternatives; adverse environmental effects that cannot be avoided should the proposal be implemented; the relationship between short-term uses of the human environment and enhancement of long-term productivity; and any irreversible and irretrievable commitments of resources.

environmental justice — The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, local, and tribal programs and policies. Executive Order 12898 directs Federal agencies to make achieving environmental justice part of their missions by identifying and addressing disproportionately high and adverse effects of agency programs, policies, and activities on minority and low-income populations.

ephemeral stream — A stream that flows only after a period of heavy precipitation.

epidemiology — Study of the occurrence, causes, and distribution of disease or other health-related states and events in human populations, often as related to age, sex, occupation, ethnic, and economic status, to identify and alleviate health problems and promote better health.

exposure limit — The level of exposure to a hazardous chemical (set by law or a standard) at which or below which adverse human health effects are not expected to occur.

Reference dose is the chronic-exposure dose (milligrams or kilograms per day) for a given hazardous chemical at which or below which adverse human noncancer health effects are not expected to occur.

Reference concentration is the chronic exposure concentration (milligrams per cubic meter) for a given hazardous chemical at which or below which adverse human noncancer health effects are not expected to occur.

***fault* —** A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred. A normal fault occurs when the hanging wall has been depressed in relation to the footwall. A reverse fault occurs when the hanging wall has been raised in relation to the footwall.

***fissile materials* —** An isotope that readily fissions after absorbing a neutron of any energy. Fissile materials are uranium-233, uranium-235, plutonium-239, and plutonium-241. Uranium-235 is the only naturally occurring fissile isotope.

***fission* —** The splitting of the nucleus of a heavy atom into two lighter nuclei. It is accompanied by the release of neutrons, gamma rays, and kinetic energy of fission products.

***fission products* —** Nuclei (fission fragments) formed by the fission of heavy elements, plus the nuclides formed by the fission fragments' radioactive decay.

***Flattop* —** A critical assembly machine designed to provide benchmark neutronic measurements in a spherical geometry with a number of different fissile driver materials. Currently located at the TA-18 facilities, subject to relocation.

***floodplain* —** The lowlands and relatively flat areas adjoining inland and coastal waters and the flood-prone areas of offshore islands. Floodplains include, at a minimum, that area with at least a 1.0 percent chance of being inundated by a flood in any given year.

> The *base floodplain* is defined as the area which has a 1.0 percent or greater chance of being flooded in any given year. Such a flood is known as a 100-year flood.
>
> The *critical action floodplain* is defined as the area which has at least a 0.2 percent chance of being flooded in any given year. Such a flood is known as a 500-year flood. Any activity for which even a slight chance of flooding would be too great (e.g., the storage of highly volatile, toxic, or water-reactive materials) should not occur in the critical action floodplain.
>
> The *probable maximum flood* is the hypothetical flood considered to be the most severe reasonably possible flood, based on the comprehensive hydrometeorological application of maximum precipitation and other hydrological factors favorable for maximum flood runoff (e.g., sequential storms and snowmelts). It is usually several times larger than the maximum recorded flood.

***flux* —** Rate of flow through a unit area; in reactor operation, the apparent flow of neutrons in a defined energy range. (See *neutron flux*.)

***formation* —** In geology, the primary unit of formal stratigraphic mapping or description. Most formations possess certain distinctive features.

***fugitive emissions* —** (1) Emissions that do not pass through a stack, vent, chimney, or similar opening where they could be captured by a control device, or (2) any air pollutant emitted to the atmosphere other than from a stack. Sources of fugitive emissions include pumps; valves; flanges; seals; area sources such as ponds, lagoons, landfills, piles of stored material (e.g., coal); and road construction areas or other areas where earthwork is occurring.

gamma radiation — High-energy, short wavelength, electromagnetic radiation emitted from the nucleus of an atom during radioactive decay. Gamma radiation frequently accompanies alpha and beta emissions and always accompanies fission. Gamma rays are very penetrating and are best stopped or shielded by dense materials, such as lead or depleted uranium. Gamma rays are similar to, but are usually more energetic than, x-rays.

genetic effects — Inheritable changes (chiefly mutations) produced by exposure of the parts of cells that control biological reproduction and inheritance to ionizing radiation or other chemical or physical agents.

GENII — A computer code used to predict the radiological impacts on individuals and populations associated with the release of radioactive material into the environment during normal operations and postulated accidents.

geology — The science that deals with the Earth: the materials, processes, environments, and history of the planet, including rocks and their formation and structure.

gigaelectron volts — 1,000 million electron volts (MeV). (See *MeV*.)

glovebox — A large enclosure that separates workers from equipment used to process hazardous material while allowing the workers to be in physical contact with the equipment; normally constructed of stainless steel, with large acrylic/lead glass windows. Workers have access to equipment through the use of heavy-duty, lead-impregnated rubber gloves, the cuffs of which are sealed in portholes in the glovebox windows.

Godiva — A fast-burst critical assembly machine currently located at the TA-18 facilities, subject to relocation.

gray — The International System of Units (SI) unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (1 gray is equal to 100 rad). (The joule is the SI unit of energy.) (See *absorbed dose*.)

ground shine — The radiation dose received from an area on the ground where radioactivity has been deposited by a radioactive plume or cloud.

groundwater — Water below the ground surface in a zone of saturation.

habitat — The environment occupied by individuals of a particular species, population, or community.

half-life — The time in which one-half of the atoms of a particular radioactive isotope disintegrate to another nuclear form. Half-lives vary from millionths of a second to billions of years.

Hazard Index — A summation of the Hazard Quotients for all chemicals being used at a site and those proposed to be added to yield cumulative levels for a site. A Hazard Index value of 1.0 or less means that no adverse human health effects (noncancer) are expected to occur.

Hazard Quotient — The value used as an assessment of non-cancer-associated toxic effects of chemicals, e.g., kidney or liver dysfunction. It is a ratio of the estimated exposure to that exposure at which it would be expected that adverse health effects would begin to be produced. It is independent of cancer risk, which is calculated only for those chemicals identified as carcinogens.

hazards classification — The process of identifying the potential threat to human health of a chemical substance.

hazardous air pollutants — Air pollutants not covered by National Ambient Air Quality Standards but which may present a threat of adverse human health or environmental effects. Those specifically listed in 40 CFR 61.01 are asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. More broadly, hazardous air pollutants are any of the 188 pollutants to be regulated or renewed under Section 112(b) of the Clean Air Act. Very generally, hazardous air pollutants are any air pollutants that may realistically be expected to pose a threat to human health or welfare.

hazardous chemical — Under 29 CFR 1910, Subpart Z, hazardous chemicals are defined as "any chemical which is a physical hazard or a health hazard." Physical hazards include combustible liquids, compressed gases, explosives, flammables, organic peroxides, oxidizers, pyrophorics, and reactives. A health hazard is any chemical for which there is good evidence that acute or chronic health effects occur in exposed employees. Hazardous chemicals include carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, agents that act on the hematopoietic system, and agents that damage the lungs, skin, eyes, or mucous membranes.

hazardous material — A material, including a hazardous substance, as defined by 49 CFR 171.8, which poses a risk to health, safety, and property when transported or handled.

hazardous substance — Any substance subject to the reporting and possible response provisions of the Clean Water Act and the Comprehensive Environmental Response, Compensation, and Liability Act.

hazardous waste — A category of waste regulated under the Resource Conservation and Recovery Act. To be considered hazardous, a waste must be a solid waste under the Resource Conservation and Recovery Act and must exhibit at least one of four characteristics described in 40 CFR 261.20 through 261.24 (i.e., ignitability, corrosivity, reactivity, or toxicity) or be specifically listed by the U.S. Environmental Protection Agency in 40 CFR 261.31 through 261.33.

high-efficiency particulate air filter — An air filter capable of removing at least 99.97 percent of particles 0.3 micrometers (about 0.00001 inches) in diameter. These filters include a pleated fibrous medium, typically fiberglass, capable of capturing very small particles.

high-level radioactive waste — High-level waste is the highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations, and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation.

high-multiplication devices — A critical assembly for producing nondestructive superprompt critical nuclear excursions. These types of devices are sometimes called prompt burst devices. (See *prompt critical device* and *nuclear excursion*.)

HIGHWAY — A computer code used for predicting routes for transporting radioactive material in the United States and calculating route-specific population density statistics.

highly enriched uranium — Uranium whose content of the fissile isotope uranium-235 has been increased through enrichment to 20 percent or more (by weight). (See *natural uranium*, *enriched uranium*, and *depleted uranium*.)

***historic resources* —** Physical remains that postdate the emergence of written records; in the United States, they are architectural structures or districts, archaeological objects, and archaeological features dating from 1492 and later.

***hot cell* —** A shielded facility that requires the use of remote manipulators for handling radioactive materials.

***hydrology* —** The science dealing with the properties, distribution, and circulation of natural water systems.

***impingement* —** The process by which aquatic organisms too large to pass through the screens of a water intake structure become caught on the screens and are unable to escape.

***incident-free risk* —** The radiological or chemical impacts resulting from emissions during normal operations and packages aboard vehicles in normal transport. This includes the radiation or hazardous chemical exposure of specific population groups such as crew, passengers, and bystanders.

***indirect jobs* —** Within a regional economic area, jobs generated or lost in related industries as a result of a change in direct employment.

***ion* —** An atom that has too many or too few electrons, causing it to be electrically charged.

***ionizing radiation* —** Alpha particles, beta particles, gamma rays, high-speed electrons, high-speed protons, and other particles or electromagnetic radiation that can displace electrons from atoms or molecules, thereby producing ions.

***irradiated* —** Exposure to ionizing radiation. The condition of reactor fuel elements and other materials in which atoms bombarded with nuclear particles have undergone nuclear changes.

***isotope* —** An atom of a chemical element with a specific atomic number and atomic mass. Isotopes of the same element have the same number of protons but different numbers of neutrons and different atomic masses.

***joule* —** A metric unit of energy, work, or heat, equivalent to 1 watt-second, 0.737 foot-pounds, or 0.239 calories.

***latent cancer fatalities* —** Deaths from cancer occurring some time after, and postulated to be due to, exposure to ionizing radiation or other carcinogens.

***limestone* —** A sedimentary rock composed mostly of the mineral calcite, $CaCO_3$.

***long-lived radionuclides* —** Radioactive isotopes with half-lives greater than 30 years.

***low-income population* —** Low-income populations, defined in terms of U.S. Bureau of the Census annual statistical poverty levels (*Current Population Reports*, Series P-60 on Income and Poverty), may consist of groups or individuals who live in geographic proximity to one another or who are geographically dispersed or transient (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect. (See *environmental justice* and *minority population*.)

low-level radioactive waste — Waste that contains radioactivity but is not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined by Section 11e (2) of the Atomic Energy Act of 1954, as amended. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level radioactive waste, provided the concentration of transuranic waste is less than 100 nanocuries per gram.

Magnitude — A number that reflects the relative strength or size of an earthquake. Magnitude is based on the logarithmic measurement of the maximum motion recorded by a seismograph. An increase of one unit of magnitude (for example, from 4.6 to 5.6) represents a 10-fold increase in wave amplitude on a seismograph recording or approximately a 30-fold increase in the energy released. Several scales have been defined, but the most commonly used are (1) local magnitude (ML), commonly referred to as "Richter magnitude," (2) surface-wave magnitude (Ms), (3) body-wave magnitude (Mb), and (4) moment magnitude (Mw). Each is valid for a particular type of seismic signal varying by such factors as frequency and distance. These magnitude scales will yield approximately the same value for any given earthquake within each scale's respective range of validity.

material access area — A type of security area that is authorized to contain a security Category I quantity of special nuclear material and which has specifically defined physical barriers, is located within a Protected Area, and is subject to specific access controls.

material control and accountability — The part of safeguards that detects or deters theft or diversion of nuclear materials and provides assurance that all nuclear materials are accounted for appropriately.

maximally exposed individual — A hypothetical individual receiving radiation doses from transporting radioactive materials on the road. For the incident-free transport operation, the maximally exposed individual would be an individual stuck in traffic next to the shipment for 30 minutes. For accident conditions, the maximally exposed individual is assumed to be an individual located approximately 33 meters (100 feet) directly downwind from the accident.

maximally exposed offsite individual — A hypothetical individual whose location and habits result in the highest total radiological or chemical exposure (and thus dose) from a particular source for all exposure routes (e.g., inhalation, ingestion, direct exposure).

maximum contaminant level — The designation for U.S. Environmental Protection Agency standards for drinking water quality under the Safe Drinking Water Act. The maximum contaminant level for a given substance is the maximum permissible concentration of that substance in water delivered by a public water system. The primary maximum contaminant levels (40 CFR 141) are intended to protect public health and are federally enforceable. They are based on health factors, but are also required by law to reflect the technological and economic feasibility of removing the contaminant from the water supply. Secondary maximum contaminant levels (40 CFR 143) are set by the U.S. Environmental Protection Agency to protect the public welfare. The secondary drinking water regulations control substances in drinking water that primarily affect aesthetic qualities (such as taste, odor, and color) relating to the public acceptance of water. These regulations are not federally enforceable, but are intended as guidelines for the states.

megawatt — A unit of power equal to 1 million watts. Megawatt-thermal is commonly used to define heat produced, while megawatt-electric defines electricity produced.

meteorology — The science dealing with the atmosphere and its phenomena, especially as relating to weather.

***MeV (million electron volts)* —** A unit used to quantify energy. In this EIS, it describes a particle's kinetic energy, which is an indicator of particle speed.

***micron* —** One-millionth of 1 meter.

***migration* —** The natural movement of a material through the air, soil, or groundwater; also, seasonal movement of animals from one area to another.

***millirem* —** One-thousandth of 1 rem.

***minority population* —** Minority populations exist where either: (a) the minority population of the affected area exceeds 50 percent, or (b) the minority population percentage of the affected area is meaningfully greater than in the general population or other appropriate unit of geographic analysis (such as a governing body's jurisdiction, a neighborhood, census tract, or other similar unit). "Minority" refers to individuals who are members of the following population groups: American Indian or Alaska Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. "Minority populations" include either a single minority group or the total of all minority persons in the affected area. They may consist of groups of individuals living in geographic proximity to one another or a geographically dispersed/transient set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect. (See *environmental justice* and *low-income population*.)

***Miocene* —** An epoch of the upper Tertiary period, spanning between about 24 and 5 million years ago.

***mitigate* —** Mitigation includes: (1) avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action; or (5) compensating for an impact by replacing or providing substitute resources or environments.

***mixed waste* —** Waste that contains both nonradioactive hazardous waste and radioactive waste, as defined in this glossary.

***Modified Mercalli Intensity* —** A level on the modified Mercalli scale. A measure of the perceived intensity of earthquake ground shaking with 12 divisions, from I (not felt by people) to XII (nearly total damage). It is a unitless expression of observed effects.

***multiplication factor* (k_{eff}) —** For a chain-reacting system, the mean number of fission neurons produced by a neutron during its life within the system. For the critical system, the multiplication factor is equal to 1. If the multiplication factor is less than 1, the system is called "subcritical." Conversely, if the multiplication factor is greater than 1, the system is called "supercritical."

***National Emission Standards for Hazardous Air Pollutants* —** Standards set by the U.S. Environmental Protection Agency for air pollutants which are not covered by National Ambient Air Quality Standards and which may, at sufficiently high levels, cause increased fatalities, irreversible health effects, or incapacitating illness. These standards are given in 40 CFR 61 and 63. National Emission Standards for Hazardous Air Pollutants are given for many specific categories of sources (e.g., equipment leaks, industrial process cooling towers, dry-cleaning facilities, petroleum refineries). (See *hazardous air pollutants*.)

National Pollutant Discharge Elimination System — A provision of the Clean Water Act which prohibits discharge of pollutants into waters of the United States unless a special permit is issued by the U.S. Environmental Protection Agency, a state, or, where delegated, a tribal government. The National Pollutant Discharge Elimination System permit lists either permissible discharges, the level of cleanup technology required for wastewater, or both.

National Register of Historic Places — The official list of the Nation's cultural resources that are worthy of preservation. The National Park Service maintains the list under direction of the Secretary of the Interior. Buildings, structures, objects, sites, and districts are included in the National Register for their importance in American history, architecture, archaeology, culture, or engineering. Properties included on the National Register range from large-scale, monumentally proportioned buildings to smaller-scale, regionally distinctive buildings. The listed properties are not just of nationwide importance; most are significant primarily at the state or local level. Procedures for listing properties on the National Register are found in 36 CFR 60.

natural uranium — Uranium with the naturally occurring distribution of uranium isotopes (approximately 0.7-weight percent uranium-235 with the remainder essentially uranium-238). (See *uranium*, *depleted uranium, enriched uranium, highly enriched uranium*, and *low-enriched uranium*.)

neutron — An uncharged elementary particle with a mass slightly greater than that of the proton. Neutrons are found in the nucleus of every atom heavier than hydrogen-1.

neutron flux — The product of neutron number density and velocity (energy), giving an apparent number of neutrons flowing through a unit area per unit time.

nitrogen — A natural element with the atomic number 7. It is diatomic in nature and is a colorless and odorless gas that constitutes about four-fifths of the volume of the atmosphere.

nitrogen oxides — Refers to the oxides of nitrogen, primarily nitrogen oxide and nitrogen dioxide. These are produced in the combustion of fossil fuels and can constitute an air pollution problem. Nitrogen dioxide emissions contribute to acid deposition and the formation of atmospheric ozone.

noise — Undesirable sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities (e.g., hearing, sleep), damage hearing, or diminish the quality of the environment.

nonattainment area — An area that the U.S. Environmental Protection Agency has designated as not meeting (i.e., not being in attainment of) one or more of the National Ambient Air Quality Standards for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants, but not for others.

nonproliferation — Preventing the spread of nuclear weapons, nuclear weapon materials, and nuclear weapon technology.

normal operations — All normal (incident-free) conditions and those abnormal conditions that frequency estimation techniques indicate occur with a frequency greater than 0.1 events per year.

Notice of Intent — Announces the scoping process. The Notice of Intent is usually published in the *Federal Register* and a local newspaper. The scoping process includes holding at least one public meeting and requesting written comments on issues and environmental concerns that an EIS should address.

***nuclear component* —** A part of a nuclear weapon that contains fissionable or fusionable material.

***nuclear criticality* —** See *criticality*.

***nuclear excursion* —** A very short time period (in milliseconds) during which the fission rate of a supercritical system increases, peaks, and then decreases to a low value.

***nuclear explosive* —** Any assembly containing fissionable and/or fusionable materials and main-charge high-explosive parts or propellants capable of producing a nuclear detonation.

***nuclear facility* —** A facility subject to requirements intended to control potential nuclear hazards. Defined in DOE directives as any nuclear reactor or any other facility whose operations involve radioactive materials in such form and quantity that a significant nuclear hazard potentially exists to the employees or the general public.

***nuclear grade* —** Material of a quality adequate for use in a nuclear application.

***nuclear material* —** Composite term applied to: (1) special nuclear material; (2) source material such as uranium, thorium, or ores containing uranium or thorium; and (3) byproduct material, which is any radioactive material that is made radioactive by exposure to the radiation incident or to the process of producing or using special nuclear material.

***nuclear radiation* —** Particles (alpha, beta, neutrons) or photons (gamma) emitted from the nucleus of unstable radioactive atoms as a result of radioactive decay.

***nuclear weapon* —** The general name given to any weapon in which the explosion results from the energy released by reactions involving atomic nuclei, either fission, fusion, or both.

***Nuclear Regulatory Commission* —** The Federal agency that regulates the civilian nuclear power industry in the United States.

***Nuclear Weapons Complex* —** The sites supporting the research, development, design, manufacture, testing, assessment, certification, and maintenance of the Nation's nuclear weapons and the subsequent dismantlement of retired weapons.

***nuclide* —** A species of atom characterized by the constitution of its nucleus and hence by the number of protons, the number of neutrons, and the energy content.

***Occupational Safety and Health Administration* —** The U.S. Federal Government agency which oversees and regulates workplace health and safety; created by the Occupational Safety and Health Act of 1970.

***off site* —** The term denotes a location, facility, or activity occurring outside of the site boundary.

***on site* —** The term denotes a location or activity occurring somewhere within the boundary of the DOE Complex site.

***outfall* —** The discharge point of a drain, sewer, or pipe as it empties into a body of water.

***ozone* —** The triatomic form of oxygen; in the stratosphere, ozone protects Earth from the Sun's ultraviolet rays, but in lower levels of the atmosphere, ozone is considered an air pollutant.

***package* —** For radioactive materials, the packaging, together with its radioactive contents, as presented for transport (the packaging plus the radioactive contents equals the package).

***packaging* —** The assembly of components necessary to ensure compliance with Federal regulations. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle tie-down system and auxiliary equipment may be designated as part of the packaging.

***paleontological resources* —** The physical remains, impressions, or traces of plants or animals from a former geologic age; may be sources of information on ancient environments and the evolutionary development of plants and animals.

***particulate matter (PM)* —** Any finely divided solid or liquid material, other than uncombined (i.e., pure) water. A subscript denotes the upper limit of the diameter of particles included. Thus, PM_{10} includes only those particles equal to or less than 10 micrometers (0.0004 inches) in diameter; $PM_{2.5}$ includes only those particles equal to or less than 2.5 micrometers (0.0001 inches) in diameter.

***peak ground acceleration* —** A measure of the maximum horizontal acceleration (as a percentage of the acceleration due to the Earth's gravity) experienced by a particle on the surface of the earth during the course of earthquake motion.

***Pennsylvanian* —** A geologic time period of the Paleozoic era, spanning between about 320 and 286 million years ago.

***perched aquifer/groundwater* —** A body of groundwater of small lateral dimensions separated from an underlying body of groundwater by an unsaturated zone.

***Permian* —** The final geologic time period of the Paleozoic era, spanning between about 286 and 245 million years ago.

***permeability* —** In geology, the ability of rock or soil to transmit a fluid.

***perennial stream* —** A stream that flows throughout the year.

***person-rem* —** The unit of collective radiation dose commitment to a given population; the sum of the individual doses received by a population segment.

***PIDAS (Perimeter Intrusion Detection and Assessment System)* —** A mutually supporting combination of barriers, clear zones, lighting, and electronic intrusion detection, assessment, and access control systems constituting the perimeter of the Protected Area and designed to detect, impede, control, or deny access to the Protected Area.

***placer* —** A surficial mineral deposit formed by mechanical concentration of valuable minerals from weathered debris, usually through the action of stream currents or waves.

***Planet* —** A general-purpose critical assembly machine designed to accommodate a wide variety of neutron multiplication experiments. Currently located at the TA-18 facilities, subject to relocation.

***playa* —** A dry lake bed in a desert basin or a closed depression that contains water on a seasonal basis.

***Pleistocene* —** The geologic time period of the earliest epoch of the Quaternary period, spanning between about 1.6 million years ago and the beginning of the Holocene epoch at 10,000 years ago. It is characterized by the succession of northern glaciations and also called the "Ice Age."

***plume* —** The elongated pattern of contaminated air or water originating at a source, such as a smokestack or a hazardous waste disposal site.

***plutonium* —** A heavy, radioactive, metallic element with the atomic number 94. It is produced artificially by neutron bombardment of uranium. Plutonium has 15 isotopes with atomic masses ranging from 232 to 246 and half-lives from 20 minutes to 76 million years.

***plutonium-239* —** An isotope of plutonium with a half-life of 24,110 years which is the primary radionuclide in weapons-grade plutonium. When plutonium-239 decays, it emits alpha particles.

***population dose* —** See *collective dose*.

***Precambrian* —** All geologic time before the beginning of the Paleozoic era. This includes about 90 percent of all geologic time and spans the time from the beginning of the Earth, about 4.5 billion years ago, to about 570 million years ago.

***prehistoric resources* —** The physical remains of human activities that predate written records; they generally consist of artifacts that may alone or collectively yield otherwise inaccessible information about the past.

***Prevention of Significant Deterioration* —** Regulations required by the 1977 Clean Air Act amendments to limit increases in criteria air pollutant concentrations above baseline in areas that already meet the National Ambient Air Quality Standards. Cumulative increases in pollutant levels after specified baseline dates must not exceed specified maximum allowable amounts. These allowable increases, also known as increments, are especially stringent in areas designated as Class I areas (e.g., national parks, wilderness areas) where the preservation of clean air is particularly important. All areas not designated as Class I are currently designated as Class II. Maximum increments in pollutant levels are also given in 40 CFR 51.166 for Class III areas, if any such areas should be so designated by the U.S. Environmental Protection Agency. Class III increments are less stringent than those for Class I or Class II areas. (See *National Ambient Air Quality Standards*.)

***prime farmland* —** Land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oil seed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, without intolerable soil erosion, as determined by the Secretary of Agriculture (Farmland Protection Act of 1981, 7 CFR 7, paragraph 658).

***probabilistic risk assessment* —** A comprehensive, logical, and structured methodology that accounts for population dynamics and human activity patterns at various levels of sophistication, considering time-space distributions and sensitive subpopulations. The probabilistic method results in a more complete characterization of the exposure information available, which is defined by probability distribution functions. This approach offers the possibility of an associated quantitative measure of the uncertainty around the value of interest.

***process* —** Any method or technique designed to change the physical or chemical character of the product.

prompt critical device — A critical assembly designed to reach the condition of prompt criticality. Prompt criticality is the nuclear physics supercriticality condition, due to neutrons released immediately during the fission process, in which a mass and geometric configuration of fissile material (uranium-233, uranium-235, plutonium-239, or plutonium-241) results in an extremely rapid increase in the number of fissions from one neutron generation to the next. Prompt criticality does not rely on the releases of delayed neutrons, which are not released immediately, but rather over a period of about one minute after fission.

Prompt criticality describes the condition in which the nuclear fission reaction is not only self-sustaining, but also increasing at a very rapid rate.

Protected Area — A type of security area defined by physical barriers (i.e., walls or fences), to which access is controlled, used for protection of security Category II special nuclear materials and classified matter and/or to provide a concentric security zone surrounding a Material Access Area (security Category I nuclear materials) or a Vital Area.

proton — An elementary nuclear particle with a positive charge equal in magnitude to the negative charge of the electron; it is a constituent of all atomic nuclei, and the atomic number of an element indicates the number of protons in the nucleus of each atom of that element.

pulsed assemblies — A critical assembly designed to produce a brief emission of neutrons and gamma radiation associated with a critical condition which lasts a fraction of a second.

Quaternary — The second geologic time period of the Cenozoic era, dating from about 1.6 million years ago to the present. It contains two epochs: the Pleistocene and the Holocene. It is characterized by the first appearance of human beings on Earth.

rad — See *radiation absorbed dose*.

radiation (ionizing) — See *ionizing radiation*.

radiation absorbed dose (rad) — The basic unit of absorbed dose equal to the absorption of 0.01 joules per kilogram (100 ergs per gram) of absorbing material.

radioactive waste — In general, waste that is managed for its radioactive content. Waste material that contains source, special nuclear, or byproduct material is subject to regulation as radioactive waste under the Atomic Energy Act. Also, waste material that contains accelerator-produced radioactive material or a high concentration of naturally occurring radioactive material may be considered radioactive waste.

radioactivity —

Defined as a process: The spontaneous transformation of unstable atomic nuclei, usually accompanied by the emission of ionizing radiation.

Defined as a property: The property of unstable nuclei in certain atoms to spontaneously emit ionizing radiation during nuclear transformations.

radioisotope or radionuclide — An unstable isotope that undergoes spontaneous transformation, emitting radiation. (See *isotopes*.)

***radon* —** A gaseous, radioactive element with the atomic number 86, resulting from the radioactive decay of radium. Radon occurs naturally in the environment and can collect in unventilated enclosed areas, such as basements. Large concentrations of radon can cause lung cancer in humans.

***RADTRAN* —** A computer code combining user-determined meteorological, demographic, transportation, packaging, and material factors with health physics data to calculate the expected radiological consequences and accident risk of transporting radioactive material.

***Record of Decision* —** A document prepared in accordance with the requirements of 40 CFR 1505.2 and 10 CFR 1021.315 that provides a concise public record of DOE's decision on a proposed action for which an EIS was prepared. A Record of Decision identifies the alternatives considered in reaching the decision; the environmentally preferable alternative; factors balanced by DOE in making the decision, and whether all practicable means to avoid or minimize environmental harm have been adopted, and, if not, the reasons they were not.

***reference concentration* —** An estimate of a toxic chemical daily inhalation of the human population (including sensitive subgroups) likely to be without an appreciable risk of harmful effects during a lifetime. Those effects are both to the respiratory system (portal-of-entry) and the peripheral to the respiratory system (extra-respiratory effects). It is expressed in units of micrograms per cubic meter.

***region of influence* —** A site-specific geographic area in which the principal direct and indirect effects of actions are likely to occur and are expected to be of consequence for local jurisdictions.

***regulated substances* —** A general term used to refer to materials other than radionuclides that may be regulated by other applicable Federal, state, or local requirements.

***rem (roentgen equivalent man)* —** A unit of dose equivalent. The dose equivalent in rem equals the absorbed dose in rad in tissue multiplied by the appropriate quality factor and possibly other modifying factors. Derived from "roentgen equivalent man," referring to the dosage of ionizing radiation that will cause the same biological effect as 1 roentgen of x-ray or gamma-ray exposure. One rem equals 0.01 sievert. (See *absorbed dose* and *dose equivalent*.)

***remediation* —** The process, or a phase in the process, of rendering radioactive, hazardous, or mixed waste environmentally safe, whether through processing, entombment, or other methods.

***remote-handled waste* —** In general, refers to radioactive waste that must be handled at a distance to protect workers from unnecessary exposure (e.g., waste with a dose rate of 200 millirem per hour or more at the surface of the waste package). (See *contact-handled waste*.)

***rhyolite* —** A fine-grained silica-rich igneous rock, the extrusive equivalent of granite.

***rightsizing* —** Facility modification, rearrangement, and refurbishment necessary to size future weapon manufacturing facilities appropriately for the workload to be accomplished. In general, rightsizing involves reduction in the size of facilities, but not in their capabilities. Rightsizing is not driven by assumptions about future DOE budget levels, but rather by the need to size facilities at the level necessary for long-term workload accomplishment.

***riparian* —** Of, on, or relating to the banks of a natural course of water.

***risk* —** The probability of a detrimental effect from exposure to a hazard. Risk is often expressed quantitatively as the probability of an adverse event occurring multiplied by the consequence of that event (i.e., the product of these two factors).

***risk assessment (chemical or radiological)* —** The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemical or radiological materials.

***roentgen* —** A unit of exposure to ionizing x- or gamma radiation equal to or producing one electrostatic unit of charge per cubic centimeter of air. It is approximately equal to 1 rad.

***runoff* —** The portion of rainfall, melted snow, or irrigation water that flows across the ground surface and eventually enters streams.

***safe, secure trailer* —** A specially modified semitrailer, pulled by an armored tractor truck, which DOE uses to transport nuclear weapons, nuclear weapons components, or special nuclear material over public highways.

***safeguards* —** An integrated system of physical protection, material accounting, and material control measures designed to deter, prevent, detect, and respond to unauthorized access, possession, use, or sabotage of nuclear materials.

***safety analysis report* —** A report that systematically identifies potential hazards within a nuclear facility, describes and analyzes the adequacy of measures to eliminate or control identified hazards, and analyzes potential accidents and their associated risks. Safety analysis reports are used to ensure that a nuclear facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations. Safety analysis reports are required for DOE nuclear facilities and as a part of applications for U.S. Nuclear Regulatory Commission licenses. The U.S. Nuclear Regulatory Commission regulations or DOE orders and technical standards that apply to the facility type provide specific requirements for the content of safety analysis reports. (See *nuclear facility*.)

***sandstone* —** A sedimentary rock composed mostly of sand-size particles cemented usually by calcite, silica, or iron oxide.

***sanitary waste* —** Waste generated by normal housekeeping activities, liquid or solid (includes sludge), which are not hazardous or radioactive.

***scope* —** In a document prepared pursuant to the National Environmental Policy Act of 1969, the range of actions, alternatives, and impacts to be considered.

***scoping* —** An early and open process for determining the scope of issues to be addressed in an EIS and for identifying the significant issues related to a proposed action. The scoping period begins after publication in the *Federal Register* of a Notice of Intent to prepare an EIS. The public scoping process is that portion of the process where the public is invited to participate. DOE also conducts an early internal scoping process for environmental assessments or EISs. For EISs, this internal scoping process precedes the public scoping process. DOE's scoping procedures are found in 10 CFR 1021.311.

***security* —** An integrated system of activities, systems, programs, facilities, and policies for the protection of restricted data and other classified information or matter, nuclear materials, nuclear weapons and nuclear weapons components, and/or DOE contractor facilities, property, and equipment.

***seismic* —** Earth vibration caused by an earthquake or an explosion.

***seismicity* —** The relative frequency and distribution of earthquakes.

***severe accident* —** An accident with a frequency of less than 10^{-6} per year that would have more severe consequences than a design-basis accident in terms of damage to the facility, offsite consequences, or both.

***sewage* —** The total organic waste and wastewater generated by an industrial establishment or a community.

***SHEBA (Solution High-Energy Burst Assembly)* —** A low-enriched uranium solution criticality machine designed to provide the capability for free-field irradiations of criticality alarm systems and the validation of dosimetry. Currently located at the TA-18 facilities, subject to relocation.

***shielding* —** In regard to radiation, any material of obstruction (bulkheads, walls, or other construction) that absorbs radiation to protect personnel or equipment.

***short-lived activation products* —** An element formed from neutron interaction that has a relatively short half-life that is not produced from the fission reaction (e.g., a cobalt isotope formed from impurities in the metal of the reactor piping).

***short-lived nuclides* —** Radioactive isotopes with half-lives no greater than about 30 years (e.g., cesium-137 and strontium-90).

***shutdown* —** For a DOE reactor, the condition in which a reactor has ceased operations, and DOE has officially declared that it does not intend to operate it further.

***sievert* —** The International System of Units (SI) unit of radiation dose equivalent. The dose equivalent in sieverts equals the absorbed dose in grays multiplied by the appropriate quality factor (1 sievert is equal to 100 rem). (See *gray*.)

***silica gel* —** An amorphous, highly adsorbent form of silicon dioxide.

***soils* —** All unconsolidated materials above bedrock. Natural earthy materials on the earth's surface, in places modified or even made by human activity, containing living matter, and supporting or capable of supporting plants out of doors.

***somatic effect* —** Any effect that may manifest in the body of the exposed individual over his or her lifetime.

***source material* —** Depleted uranium, normal uranium, thorium, or any other nuclear material determined, pursuant to Section 61 of the Atomic Energy Act of 1954, as amended, to be source material, or ores containing one or more of the foregoing materials in such concentration as may be determined by regulation.

***source term* —** The amount of a specific pollutant (e.g., chemical, radionuclide) emitted or discharged to a particular environmental medium (e.g., air, water) from a source or group of sources. It is usually expressed as a rate (i.e., amount per unit time).

***special nuclear materials* —** As defined in Section 11 of the Atomic Energy Act of 1954, special nuclear material means: (1) plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the U.S. Nuclear Regulatory Commission determines to be special nuclear material; or (2) any material artificially enriched by any of the above.

spectral (response) acceleration — An approximate measure of the acceleration (as a percentage of the acceleration due to Earth's gravity) experienced by a building, as modeled by a particle on a massless vertical rod having the same natural period of vibration as the building.

spectral characteristics — The natural property of a structure as it relates to the multidimensional temporal accelerations.

staging — The process of using several layers to achieve a combined effect greater than that of one layer.

START I and II — Terms which refer to negotiations between the United States and Russia (formerly the Soviet Union) during Strategic Arms Reduction Treaty (START) I negotiations aimed at limiting and reducing nuclear arms. START I discussions began in 1982 and eventually led to a ratified treaty in 1988. START II protocol, which has not been fully ratified, will attempt to further reduce the acceptable levels of nuclear weapons ratified in START I.

stockpile — The inventory of active nuclear weapons for the strategic defense of the United States.

stockpile stewardship program — A program that ensures the operational readiness (i.e., safety and reliability) of the U.S. nuclear weapons stockpile by the appropriate balance of surveillance, experiments, and simulations.

sulfur oxides — Common air pollutants, primarily sulfur dioxide, a heavy, pungent, colorless gas (formed in the combustion of fossil fuels, considered a major air pollutant), and sulfur trioxide. Sulfur dioxide is involved in the formation of acid rain. It can also irritate the upper respiratory tract and cause lung damage.

surface water — All bodies of water on the surface of the earth and open to the atmosphere, such as rivers, lakes, reservoirs, ponds, seas, and estuaries.

Tertiary — The first geologic time period of the Cenozoic era (after the Mesozoic era and before the Quaternary period), spanning between about 66 and 1.6 million years ago. During this period, mammals became the dominant life form on Earth.

threat-1 — (1) A person, group, or movement with intentions to use extant or attainable capabilities to undertake malevolent actions against DOE interests; (2) the capability of an adversary coupled with his intentions to undertake any actions detrimental to the success of program activities or operation.

threatened species — Any plants or animals likely to become endangered species within the foreseeable future throughout all or a significant portion of their ranges and which have been listed as threatened by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures set in the Endangered Species Act and its implementing regulations (50 CFR 424). (See *endangered species*.)

threshold limit values — The recommended highest concentrations of contaminants to which workers may be exposed according to the American Conference of Governmental Industrial Hygienists.

total effective dose equivalent — The sum of the effective dose equivalent from external exposures and the committed effective dose equivalent from internal exposures.

transuranic — Refers to any element whose atomic number is higher than that of uranium (atomic number 92), including neptunium, plutonium, americium, and curium. All transuranic elements are produced artificially and are radioactive.

transuranic waste — Radioactive waste not classified as high-level radioactive waste and that contains more than 100 nanocuries (3,700 becquerels) per gram of alpha-emitting transuranic isotopes with half-lives greater than 20 years.

tuff — A fine-grained rock composed of ash or other material formed by volcanic explosion or aerial expulsion from a volcanic vent.

Type B packaging — A regulatory category of packaging for transportation of radioactive material. The U.S. Department of Transportation and U.S. Nuclear Regulatory Commission require Type B packaging for shipping highly radioactive material. Type B packages must be designed and demonstrated to retain their containment and shielding integrity under severe accident conditions, as well as under the normal conditions of transport. The current U.S. Nuclear Regulatory Commission testing criteria for Type B package designs (10 CFR 71) are intended to simulate severe accident conditions, including impact, puncture, fire, and immersion in water. The most widely recognized Type B packages are the massive casks used for transporting spent nuclear fuel. Large-capacity cranes and mechanical lifting equipment are usually needed to handle Type B packages.

Type B shipping cask — A U.S. Nuclear Regulatory Commission-certified cask with a protective covering that contains and shields radioactive materials, dissipates heat, prevents damage to the contents, and prevents criticality during normal shipment and accident conditions. It is used for transport of highly radioactive materials and is tested under severe, hypothetical accident conditions that demonstrate resistance to impact, puncture, fire, and submersion in water.

uranium — A radioactive, metallic element with the atomic number 92; one of the heaviest naturally occurring elements. Uranium has 14 known isotopes, of which uranium-238 is the most abundant in nature. Uranium-235 is commonly used as a fuel for nuclear fission. (See *natural uranium, enriched uranium, highly enriched uranium*, and *depleted uranium*.)

vault (special nuclear material) — A penetration-resistant, windowless enclosure having an intrusion alarm system activated by opening the door and which also has: (1) walls, floor, and ceiling substantially constructed of materials which afford forced-penetration resistance at least equivalent to that of 8-inch-thick reinforced concrete; (2) a built-in combination-locked steel door which, for existing structures, is at least 1 inch thick exclusive of bolt work and locking devices and which, for new structures, meets standards set forth in Federal specifications and standards.

viewshed — The extent of an area that may be viewed from a particular location. Viewsheds are generally bounded by topographic features such as hills or mountains.

vital area — A type of DOE security area that is located within the Protected Area and that has a separate perimeter and access controls to afford layered protection, including intrusion detection, for vital equipment.

Visual Resource Management class — Any of the classifications of visual resources established through application of the Visual Resources Management process of the Bureau of Land Management. Four classifications are employed to describe different degrees of modification to landscape elements: Class I-areas where the natural landscape is preserved, including national wilderness areas and the wild sections of national wild and scenic rivers; Class II-areas with very limited land development activity, resulting in visual contrasts that are seen but do not attract attention; Class III-areas in which development may attract attention, but the natural landscape still dominates; and Class IV-areas in which development activities may dominate the view and may be the major focus in the landscape.

volatile organic compounds — A broad range of organic compounds, often halogenated, that vaporize at ambient or relatively low temperatures, such as benzene, chloroform, and methyl alcohol. In regard to air pollution, any organic compound that participates in atmospheric photochemical reaction, except for those designated by the U.S. Environmental Protection Agency administrator as having negligible photochemical reactivity.

waste classification — Waste is classified according to DOE Order 435.1, *Radioactive Waste Management* and includes high-level radioactive, transuranic, and low-level radioactive waste.

waste management — The planning, coordination, and direction of those functions related to the generation, handling, treatment, storage, transportation, and disposal of waste, as well as associated surveillance and maintenance activities.

waste minimization and pollution prevention — An action that economically avoids or reduces the generation of waste and pollution by source reduction, reducing the toxicity of hazardous waste and pollution, improving energy use, or recycling. These actions will be consistent with the general goal of minimizing present and future threats to human health, safety, and the environment.

watt — A unit of power equal to 1 joule per second. (See *joule*)

weapons grade — Fissionable material in which the abundance of fissionable isotopes is high enough that the material is suitable for use in thermonuclear weapons.

weighting factor — Generally, a method of attaching different importance values to different items or characteristics. In the context of radiation protection, the proportion of the risk of effects resulting from irradiation of a particular organ or tissue to the total risk of effects when the whole body is irradiated uniformly (e.g., the organ dose weighting factor for the lung is 0.12, compared to 1.0 for the whole body). Weighting factors are used for calculating the effective dose equivalent.

wetland — Wetlands are "... those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR 328.3).

whole-body dose — In regard to radiation, dose resulting from the uniform exposure of all organs and tissues in a human body. (See *effective dose equivalent*.)

wind rose — A circular diagram showing, for a specific location, the percentage of the time the wind is from each compass direction. A wind rose for use in assessing consequences of airborne releases also shows the frequency of different wind speeds for each compass direction.

X/Q (Chi/Q) — The relative calculated air concentration due to a specific air release; units are seconds per cubic meter (sec/m^3).

yield — The force in tons of TNT of a nuclear or thermonuclear explosion.

CHAPTER 9

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CHAPTER 10

List of Preparers

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10. LIST OF PREPARERS

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Experience/Technical Specialty:
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Education: M.S., Nuclear Engineering, University of Utah
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Experience/Technical Specialty:
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BENROMDHANE, SOUAD A., SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: AIR QUALITY MODELING

Education: Ph.D., Environmental Engineering, Michigan State University
M.S., Geotechnical Engineering, École Polytechnique de Paris
B.S. & M.S., Civil Engineering, École Nationale d'Ingenieurs de Tunis

Experience/Technical Specialty:
Twelve years. Air quality modeling, hazardous chemical risk calculation.

GARY DEMOSS, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: TRANSPORTATION ANALYSIS

Education: M.S., Engineering Administration, Virginia Polytechnic Institute
B.S., Mechanical Engineering, University of Virginia

Experience/Technical Specialty:
Eighteen years. Transportation risk analysis and reliability and safety engineering.

ABRAHAM L. EISS, ENERCORP
EIS RESPONSIBILITIES: EDITORIAL SUPPORT

Education: M.S., Engineering Management, Drexel University
M.S., Materials Engineering, Purdue University
B.S., Materials Engineering

Experience/Technical Specialty:
Forty-five years. Industry and government regulatory experience in the nuclear field including nuclear fuel research and development, regulatory standards, project management.

KEVIN T. FOLK, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: WATER RESOURCES, GEOLOGY, AND SOILS

Education: M.S., Environmental Biology, Hood College
B.A., Geoenvironmental Studies, Shippensburg University

Experience/Technical Specialty:
Twelve years. Water resources management, NPDES permitting and regulatory analysis, and earth resources and geologic hazards assessment.

DANIEL W. GALLAGHER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: RADIOLOGICAL IMPACTS, NORMAL OPERATIONS ANALYSIS

Education: M.E., Nuclear Engineering, Rensselaer Polytechnic Institute
B.S., Nuclear Engineering, Rensselaer Polytechnic Institute

Experience/Technical Specialty:
Twenty-one years. Reliability and risk engineering, probabilistic safety assessments, plant design, and regulatory analysis.

DIANE HARMS, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: TECHNICAL EDITING

Education: B.F.A., Fine Art, University of Connecticut

Experience/Technical Specialty:
Sixteen years. Technical writing and editing.

CATHY HAUPT, *SCIENCE APPLICATIONS INTERNATIONAL CORPORATION*
***EIS* RESPONSIBILITIES:** PROJECT ADMINISTRATION/RESEARCH SPECIALIST

Education: M.S., Science Education, Clarion University
B.S., Secondary Education, Clarion University

Experience/Technical Specialty:
Twenty years. Environmental compliance, project management, research, and training.

ROBERT G. HOFFMAN, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: ENVIRONMENTAL IMPACTS AND PUBLIC PARTICIPATION PROCESS.

Education: B.S., Environmental Resource Management, Pennsylvania State University

Experience/Technical Specialty:
Fifteen years. NEPA compliance, regulatory review, public participation support, and land use planning.

CATHY HUSS, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: WASTE MANAGEMENT, SOCIOECONOMICS

Education: M.S.E.S., Environmental Science, Indiana University
M.S., Secondary Education, Indiana University
B.S., Biology, Indiana University

Experience/Technical Specialty:
Nine years. Environmental chemistry, NEPA documentation, and regulatory review.

ROY KARIMI, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: PROJECT ENGINEER, TECHNICAL CONTENT SUPERVISOR

Education: Sc.D., Nuclear Engineering, Massachusetts Institute of Technology
N.E., Nuclear Engineering, Massachusetts Institute of Technology
M.S., Nuclear Engineering, Massachusetts Institute of Technology
B.Sc., Chemical Engineering, Abadan Institute of Technology

Experience/Technical Specialty:
Twenty-five years. Nuclear power plant safety, risk and reliability analysis, design analysis, criticality analysis, accident analysis, consequence analysis, spent fuel dry storage safety analysis, and probabilistic risk assessments.

JASPER G. MALTESE, PARALLAX, INCORPORATED
EIS RESPONSIBILITIES: ACCIDENT ANALYSIS, SUPERVISOR OF RADIOLOGICAL IMPACTS

Education: M.S., Operations Research, George Washington University
B.S., Operations Research, George Washington University

Experience/Technical Specialty:
Thirty-eight years. NEPA assessments, accident analyses, safety analysis report reviews, facility safety audits, and system reliability analyses.

PATRICK MCCLURE, LOS ALAMOS NATIONAL LABORATORY
EIS RESPONSIBILITIES: LANL INPUT ON ACCIDENT ANALYSIS

Education: M.S., Mechanical Engineering, University of New Mexico
B.S., Petroleum Engineering, University of Oklahoma

Experience/Technical Specialty:
Seventeen years. Nuclear safety analysis, research and development, and oil industry.

STEVEN M. MIRSKY, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: ENGINEERING SUPPORT AND CRITICALITY

Education: M.S., Nuclear Engineering, Pennsylvania State University
B.S., Mechanical Engineering, Cooper Union
Professional Engineer (Mechanical, Maryland)

Experience/Technical Specialty:
Twenty-five years. Assistant Vice President, safety analysis, nuclear power plant design, operations, foreign nuclear power plant system analysis, accident analysis, thermal hydraulics, and spent nuclear fuel dry storage safety analysis.

EVELYN M. MULLEN, LOS ALAMOS NATIONAL LABORATORY
EIS RESPONSIBILITIES: LANL TA-18 RELOCATION PROJECT DIRECTOR, LANL ALTERNATIVES DEVELOPMENT

Education: M.S., Nuclear Engineering, Texas A&M University
B.S., Nuclear Engineering, Texas A&M University
Professional Engineer (New Mexico)

Experience/Technical Specialty:
Seventeen years. Nuclear facility operations, research reactor operations, and safety analysis.

JILL E. REILLY, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: ECOLOGICAL RESOURCES AND CONSULTATIONS

Education: B.S., Environmental Conservation, University of New Hampshire

Experience/Technical Specialty:
Seven years. NEPA compliance, ecological field assessments, and hazardous materials transportation.

JEFFREY J. RIKHOFF, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: DEPUTY PROJECT MANAGER, SUPERVISOR OF NONRADIOLOGICAL RESOURCE AREAS

Education: M.R.P., Regional/Environmental Planning, University of Pennsylvania
M.S., International Economic Development and Appropriate Technology, University of Pennsylvania
B.A., English, DePauw University

Experience/Technical Specialty:
Fifteen years. NEPA compliance, regulatory compliance and permitting, socioeconomics, environmental justice, comprehensive land-use and development planning, and cultural resources.

ROBERT SAMWORTH, ENERCORP
EIS RESPONSIBILITIES: REGULATORY COMPLIANCE

Education: Ph.D., Environmental Engineering, Cornell University
M.S.E., Environmental Engineering, The Johns Hopkins University
B.S., Civil Engineering, University of Delaware

Experience/Technical Specialty:
Twenty-five years. Industry and regulatory experience in nuclear industry, NEPA documentation, and regulatory reviews.

JAMES R. SCHINNER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: LAND, ECOLOGICAL, CULTURAL, AND PALEONTOLOGICAL RESOURCES

Education: Ph.D., Wildlife Management, Michigan State University
M.S., Zoology, University of Cincinnati
B.S., Zoology, University of Cincinnati

Experience/Technical Specialty:
Twenty-eight years. Ecological field assessments, NEPA documentation, and regulatory reviews.

ROBERT L., SCHLEGEL, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: RADIOLOGICAL IMPACTS, SITE BASELINE OPERATIONS

Education: M.S., Nuclear Engineering, Columbia University
B.S., Chemical Engineering, Massachusetts Institute of Technology
N.E., Nuclear Engineering, Columbia University

Experience/Technical Specialty:
Thirty-nine years. Human health assessments, radiological dose analyses, waste management evaluations.

EDWARD Y. SHUM, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: ENGINEERING SUPPORT, DECONTAMINATION AND DECOMMISSIONING

Education: Ph.D., Environmental and Nuclear Chemistry, Oregon State University
M.S., Nuclear Chemistry, Oregon State University
B.S., Chemistry, University of California, Berkeley

Experience/Technical Specialty:
Twenty-seven years. Licensing, nuclear facilities, spent nuclear fuel, senior safety and environmental project manager, health physics, dose assessments, and decommissioning and emergency planning.

CARL A. SNYDER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: ACCIDENT ANALYSIS

Education: B.S., Nuclear Engineering, University of Maryland
B.S., Mathematics, University of Maryland

Experience/Technical Specialty:
Eleven years. Nuclear safety, nuclear criticality, thermal hydraulics, licensing, accident analysis, and dose consequences.

MARY ALICE SPIVEY, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: REGULATORY COMPLIANCE OVERSIGHT, WASTE MANAGEMENT

Education: B.S., Environmental Sciences, Florida Institute of Technology

Experience/Technical Specialty:
Nineteen years. Regulatory analysis and compliance, waste management, and environmental restoration.

ELLEN TAYLOR, LOS ALAMOS NATIONAL LABORATORY
EIS RESPONSIBILITIES: LANL EIS COORDINATOR

Education: Ph.D., Biology, University of Pennsylvania
B.A., Zoology, University of Vermont

Experience/Technical Specialty:
Twenty years. Environmental compliance and NEPA assessments.

BHASKER (BOB) P. TRIPATHI, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: CIVIL/STRUCTURAL ENGINEERING SUPPORT

Education: M.S., Civil/Structural Engineering, University of Cincinnati
B.S., Civil Engineering, Gujarat University, India
Licensed Professional Engineer (Civil - California, Maryland, Virginia)

Experience/Technical Speciality:
Thirty-four years. Chief Engineer; civil/structural and seismic analysis/design of structures, systems, and components for DOE and NRC-licensed facilities; nuclear power plants; seismic deterministic and probabilistic analysis; aircraft crash analysis/design; seismic/structural analysis of independent spent fuel storage installations using dry cask storage systems.

ROBERT H. WERTH, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: NOISE ANALYSIS, AIR QUALITY MODELING

Education: B.A., Physics, Gordon College

Experience/Technical Specialty:
Twenty-six years. Acoustics and air quality analysis, regulatory reviews, and NEPA documentation.

JOHN W. WILLIAMS, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: GEOGRAPHICAL INFORMATION SYSTEMS SUPPORT, DEMOGRAPHICS, ENVIRONMENTAL JUSTICE

Education: Ph.D., Physics, New Mexico State University
M.S., Physics, New Mexico State University
B.S., Mathematics, North Texas State University

Experience/Technical Speciality:
Twenty-nine years. Geographical information systems, demographics.

ELIZABETH WITHERS, U.S. DEPARTMENT OF ENERGY, NATIONAL NUCLEAR SECURITY ADMINISTRATION (NEPA COMPLIANCE OFFICER, LOS ALAMOS AREA OFFICE)
EIS RESPONSIBILITIES: LANL SITE REVIEWER

Education: M.S., Life Sciences, Louisiana Tech University
B.S., Botany, Louisiana Tech University

Experience/Technical Specialty:
Eighteen years. Environmental compliance and investigations and NEPA compliance.

CHAPTER 11

Distribution List

TA-18

11. DISTRIBUTION LIST

The U.S. Department of Energy provided copies of the *Draft Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory (TA-18 Relocation EIS)* or the Summary to Federal, state, and local elected and appointed government officials and agencies; Native American representatives; national, state, and local environmental and public interest groups; and other organizations and individuals listed in this chapter. Approximately 400 copies of the Draft *TA-18 Relocation EIS* and 500 copies of the Summary of the Draft *TA-18 Relocation EIS* were sent to interested parties. Copies will be provided to others upon request.

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Mike Simpson, R-Idaho
Joe Skeen, R-New Mexico
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Ralph M. Hall, Committee on Science
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Lynn Woolsey, Subcommittee on Energy

U.S. Senate

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Harry Reid, D-Nevada

U.S. Senate Committees

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Bob Graham, Subcommittee on Energy Research, Development, Production, and Regulation
Frank H. Murkowski, Committee on Energy and Natural Resources
Don Nickles, Subcommittee on Energy Research, Development, Production, and Regulation
Harry Reid, Subcommittee on Energy and Water Development

Federal Agencies

Advisory Council on Historic Preservation
Bureau of Land Management
Defense Nuclear Facilities Safety Board
Department of Defense
Department of the Interior
Department of Transportation
Environmental Protection Agency
Geological Survey
Nuclear Regulatory Commission

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Gevene Savala, Kaibab Paiute Indian Tribe, Fredonia

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Darryl King, Chemehuevi Paiute Tribe, Havasu Lake
Charlotte Domingo, Shivwitts Band of Southern Paiutes, Santa Clara
Priscilla Naylor, Fort Independence Paiute Tribe, Independence
Wendy Stine, Chairperson, Fort Independence Paiute Tribe, Independence
Vernon Miller, Fort Independence Paiute Tribe, Independence
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Rachel Joseph, Lone Pine Pauite/Shoshone Tribe, Lone Pine
Sandra Yonge, Chairperson, Lone Pine Paiute/Shoshone Tribe, Lone Pine
Pauline Esteves, Chairperson, Timbisha Shoshone Tribe, Death Valley
Grace Goad, Timbisha Shoshone Tribe, Death Valley

Idaho
Lionel Boyer, Chairman, Fort Hall Business Council, Shoshone-Bannock Tribes, Fort Hall
Diana Yupe, Shoshone-Bannock Tribes, Fort Hall

Nevada

Tim Thompson, Chairperson, Duckwater Shoshone Tribe, Duckwater
Ron Apodaca, Chairperson, Ely Shoshone Tribe, Ely
Jerry Charles, Ely Shoshone Tribe, Ely
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Lila Carter, Las Vegas Paiute Tribe, Las Vegas
Calvin Meyers, Moapa Band of Paiutes, Moapa
Lalovi Miller, Moapa Band of Paiutes, Moapa
Eugene Tom, Chairperson, Moapa Band of Paiutes, Moapa
Richard Arnold, Pahrump Paiute Tribe, Pahrump
Clarabelle Jim, Pahrump Paiute Tribe, Las Vegas
Cynthia Jim, Pahrump Paiute Tribe, Pahrump
Mr. Brady Sr., Chairperson, Yomba Shoshone Tribe, Austin
Maurice Frank Churchill, Yomba Shoshone Tribe, Austin

New Mexico

Sara Misquez, President, Mescalero Apache, Mescalero
Bernie Teba, Director, Eight Northern Indian Pueblo Council, San Juan Pueblo
Wilson Romero, Governor, Pueblo of Cochiti, Cochiti Pueblo
Joe Gajerro, Governor, Pueblo of Jemez, Jemez Pueblo
Denny Gutierrez, Governor, Pueblo of Santa Clara, Española
Perry Martinez, Governor, Pueblo of San Ildefonso, Santa Fe
David Sarracino, Pueblo of San Ildefonso, Santa Fe
Michael Taylor, Pueblo of San Ildefonso, Santa Fe
Joseph Chavarria, Pueblo of Santa Clara, Española
Cyrus Chino, Pueblo of Acoma, Acoma
Neil Weber, Pueblo of San Ildefonso, Santa Fe

Utah

General Anderson, Chairperson, Paiute Tribe of Utah, Cedar City
Gloria Bullets Benson, Paiute Tribe of Southern Utah, Cedar City
Eldene Cervantes, Shivwitts Band of Southern Paiutes, Santa Clara

NEPA State Point of Contacts

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Kathleen Trever, Idaho
Heather Elliott, Nevada
Peter Maggiore, New Mexico

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Nongovernmental Organizations

Dorie Bunting, Albuquerque Center for Peace and Justice
Bob Hoffman, Albuquerque Economic Forum
Kathy Crandall, Alliance for Nuclear Accountability
LaDonna Harris, Americans for Indian Opportunity
Roy Weaver, Bandelier National Monument
M. F. Huebner, Bonneville County Sportsman Association
Carpenters' Local 808
Traci Massey, Center for Environmental Management
Sue Dayton, Citizens' Action
Mary Dazey, Citizen Alert
John Hadder, Citizens' Alert
Kalynda Telges, Citizens' Alert
Kalynda Tilges, Citizen Alert
Janet Greenwald, Citizens for Alternatives to Radioactive Dumping
Frank Martinez, Citizens' Information Committee of Martineztown
Ted Carpenter, Coalition-21
George Freund, Coalition-21
Joni Arends, Concerned Citizens for Nuclear Safety
Suzanne Westerly, Concerned Citizens for Nuclear Safety
David Shafer, Desert Research Institute
John Shafer, DRI
The East Manzano Alliance
Fred Rael, East Mountain Area Association
Chuck Broscious, Environmental Defense Institute
Tom Carpenter, Government Accountability Project
Damon Moglen, Greenpeace International
Raymond Burstedt, Idaho Small Business Development Center
Wendy Green Lowe, INEEL Citizens' Advisory Board
Keep Yellowstone Nuclear Free
Greg Mello, Los Alamos Study Group
Jesse Dompreh, National Association for the Advancement of Colored People
JoAnn Chase, National Congress of American Indians
David Simon, National Parks and Conservation Association
Thomas B. Cochran, National Resources Defense Council
Jerry Pardilla, National Tribal Environmental Council
National Wild Horse Association
Thomas Cochran, Natural Resources Defense Council
Teri Knight, Nature Conservancy
T. E. Wade, Nevada Alliance for Defense, Business, and Industry
James Morefield, Nevada Natural Heritage Program

Kay Planamento, Nevada Test Site Citizens' Advisory Board
K. M. Reim, Nevada Test Site Citizens' Advisory Board
Lorenzo Valdez, New Mexico Alliance
Wallace Ford, New Mexico Conference of Churches
Doug Melklejohn, New Mexico Environmental Law Center
Steve Schmidt, New Mexico Green Party
Nick Rusen, New Mexico Public Interest Research Group
Steven Dolley, Nuclear Control Institute
Jay Coghlan, Nuclear Watch of New Mexico
Peggy Prince, Peace Action of New Mexico
Virginia Miller, People for Peace
John Landreth, People for the West
Dan Kerlinsky, Physicians for Social Responsibility
Robert Musil, Physicians for Social Responsibility
Christine Chandler, Responsible Environmental Action League
Juan Montes, Rural Alliance for Military Accountability
Dolores Herrera, San Jose Community Awareness Council
Alice Roos, Sanctuary Foundation
Bill Arthur, Sierra Club
Jim Bloomquist, Sierra Club
Barbara Boyle, Sierra Club
Jack Hession, Sierra Club
Virginia Olivera, Sierra Club
Michael Smith, Sierra Club
Rob Smith, Sierra Club
Beatrice Brailsford, Snake River Alliance
Gary Richardson, Snake River Alliance
Margaret Stewart, Snake River Alliance
Michael Guerrero, Southwest Organizing Project
Don Hancock, Southwest Research and Information Center
William Robinson, Southwest Research and Information Center
Fritz Bjornsen, Snake River Alliance
Eddie Chew, Snake River Audubon Society
South Valley Improvement Coalition
Mary Wilson, Transitions to Tomorrow, Inc.
Gilbert Sanchez, Tribal Environmental Watch Alliance
Tom Zamora Collina, Union of Concerned Scientists
Peter Rickards, Vote on INEEL
Jackie Cabasso, Western States Legal Foundation
Dawn Lappin, Wild Horse Organized Assistance
Wildlife and Habitat Improvement of Nevada

Reading Rooms and Libraries

Gale Willmore
U.S. Department of Energy
Public Reading Room
1776 Science Center Drive
Idaho Falls, Idaho 83415

Carolyn Lawson
U.S. Department of Energy
FOI Public Reading Room
1000 Independence Avenue, SW
1-E-190
Washington, DC 20585

Dan Barkley
University of New Mexico
Government Information Department
Zimmerman Library
Albuquerque, New Mexico 87131

University of Idaho Library
University Avenue and Rayburn Street
Moscow, Idaho 83844

Idaho State University Library
741 South 7th Avenue
Pocatello, Idaho 83209

Idaho Falls Public Library
457 Broadway
Idaho Falls, Idaho 83401

DOE Nevada Operations Office
Public Reading Facility
2621 Losee Road
North Las Vegas, NV 89030

Shoshone-Bannock Library
PO Box 306
Fort Fall, Idaho 83203

William Beale
College of Southern Idaho Library
315 Falls Avenue
Twin Falls, Idaho 83303

Linda Parkinson
Twin Falls Public Library
434 2nd Street East
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Harold Kline
Lawrence Knight
Mark Koffer
Bart Krawetz
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Brent Perkins
Chuck Pergler
Walter Perry
D. Raymond Perry, Jr.
Dan Pilotte
Wendell Phillips

Wayne Pierre
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Sam Pole
C. F. Poor
Kevin Poor
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Ron Porter
Dennis and Margo Proksa
William J. Quapp
Paul Randolph
Bert Raynes
Huey Reed
Charles M. Rice
Dixi Richardson
Norman Ricks
Ann Riedesel
Erik Ringleberg
Sandra Roe
N. K. Rogers
Carmen M. Rodriquez
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F. Dave Rydalch
Ted Sand
Cary Sargent
Ted C. Sauvageau
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Richard Schlueter
David Schreiber
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Dave Sealander
Mark Shaltry
G. N. Sharp
Jeanine M. Shreeve
Shanna Shurtliff
Carta Sierra
Craig Simon
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Bryan Smith
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E. R. Smith
Kim D. Smith
Merle Smith
Michael Smith
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Nettie Smoot
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Timothy Stirrup
Susan Stiger
Steve and Barbara Stoddard
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Greg Taylor
Ruston Taylor
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Diane Terry
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Jim Tibbitts
Rochelle Trammel
Kathleen Trevor
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William Wickberg
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Ron Wizelman
James Wolski
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Steven Zohner

DOE/EIS-319D
August 2001

Draft Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory

United States Department of Energy
National Nuclear Security Administration
Washington, DC 20585

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Appendix I

Acronyms, Abbreviations, and Conversion Charts

TA-18

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ANL-W	Argonne National Laboratory-West
BEIR	Biological Effects of Ionizing Radiation
CASA	Critical Assembly Storage Area
CAV	critical assembly vessel
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
DAF	Device Assembly Facility
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
EA	environmental analysis
EBR-II	Experimental Breeder Reactor-II
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FFTF	Fast Flux Test Facility
FMF	Fuel Manufacturing Facility
FR	*Federal Register*
FY	fiscal year
GPEB	general-purpose experimental building
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
KAFB	Kirtland Air Force Base
LACEF	Los Alamos Critical Experiments Facility
LANL	Los Alamos National Laboratory
MESA	Microsystems and Engineering Sciences Applications
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NMAC	New Mexico Administrative Code
NMSF	Nuclear Material Storage Facility
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NTS	Nevada Test Site
OSHA	Occupational Safety and Health Administration
PEIS	programmatic environmental impact statement
PIDAS	Perimeter Intrusion Detection and Assessment System
PM_n	particulate matter less than or equal to n microns in aerodynamic diameter
RCRA	Resource Conservation and Recovery Act
SARP	Safety Analysis Report for Packaging
SEA	special environmental analysis
SHEBA	Solution High-Energy Burst Assembly
SNL/NM	Sandia National Laboratories/New Mexico
SNM	special nuclear material(s)
START	Strategic Arms Reduction Treaty

SWEIS	sitewide environmental impact statement
TA	technical area
TA-18	Technical Area 18
TREAT	Transient Reactor Test Facility
USFWS	United States Fish and Wildlife Service
U.S.C.	*United States Code*
ZPPR	Zero Power Physics Reactor

Metric Conversion Chart

To Convert Into Metric			*To Convert From Metric*		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092903	square meters	square meters	10.7639	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.40469	hectares	hectares	2.471	acres
square miles	2.58999	square kilometers	square kilometers	0.3861	square miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32, then multiply by 0.55556	Celsius	Celsius	Multiply by 1.8, then add 32	Fahrenheit

Metric Prefixes

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

APPENDIX A

Critical Assembly Descriptions

APPENDIX A
CRITICAL ASSEMBLY DESCRIPTIONS

This appendix provides a brief description of TA-18 critical assembly machines and their characteristics. Descriptions of the critical assembly machines are limited to those that are currently operating and would be relocated under the TA-18 relocation alternatives.

A.1 CRITICAL ASSEMBLY MACHINES

The critical assemblies, or assembly machines, at TA-18 have been in existence since 1946 (DOE 2001). Since then, many thousands of criticality measurements have been made on assemblies of fissile material (uranium-235, uranium-233, and plutonium-239) in various configurations, including the nitrate, sulfate, fluoride, carbide, and oxide chemical compositions and the solid, liquid, and gaseous states. At present, the complex consists of five operating machines that include roughly five types of assemblies:

- Benchmark critical assemblies (Flattop)
- Assembly machines used to remotely assemble critical experiments (Comet and Planet)
- Solution assemblies in which the fuel is a fissile solution (Solution High-Energy Burst Assembly [SHEBA])
- Prototype reactor assemblies that operate at low power without the need for heat-rejection systems
- Fast-burst assemblies for producing fast neutron pulses (Godiva)

The critical assemblies at TA-18 are a unique category of nuclear research reactors. The critical assemblies, are clearly classified as Category B research reactors in U.S. Department of Energy (DOE) Order 5480.30, yet they share little in common with most permanently configured research reactors. Some of the fundamental differences are (LANL 1998, DOE 2001):

- Critical assemblies are designed to operate at low average power (milliwatts to a few kilowatts) for short periods of time. They do not require coolant systems, which reduces the overall complexity of the assemblies.

- Critical assemblies include machines designated as fast burst reactors, (i.e., Godiva). These reactors normally operate in a pulse mode at a very high peak power, with total pulse widths on the order of 100 microseconds leading to a total energy yield per pulse of about ~1 megajoule. Each pulse operation is initiated from room temperature. Thus, these reactors share a low-energy release-rate behavior compared with the traditional critical assemblies.

- Because they operate at low average power for short periods, they do not build up a significant radiological inventory of long-lived fission products. The majority of the fission products remain within the fuel material and decay to stable isotopes. This eliminates problems with decay heat and makes the critical assemblies "walk-away" safe after a safe shutdown. Furthermore, most of the assemblies can be accessed shortly after operating with relatively minor radiation protection requirements.

As a result of these three differences, there is no need for engineered safeguards such as decay heat removal systems, emergency core coolant systems, engineered containment structures, etc. A simple confinement building to mitigate the consequences of design basis accidents is all that is needed.

The critical assemblies at TA-18 are experimental systems that are designed and reconfigured for the needs of an experimental program. Two generic classes of machines are used:

- Permanently configured assemblies with fuel and control elements mounted on the machine (Flattop, Godiva, and SHEBA)

- Critical experiment remote assembly machines that serve as stable platforms for assembling fuel components and control elements for remote operation (Comet and Planet)

Since this discussion of the operation and controls of critical assemblies uses various technical terms relevant to criticality safety, a brief discussion of the technical concepts and terms is provided below.

A critical assembly is a system of fissile material with or without a reflector (beryllium, copper, iron, etc.) in a specific shape and geometry. The critical assembly can be gradually built up by adding additional fissile material and/or reflector until this system achieves the dimensions necessary for sustaining a constant rate of fission in a chain reaction (a nuclear reaction), known as critical condition. The minimum quantity of fissile material capable of sustaining such a reaction is called the critical mass for that assembly. Critical mass is a function of the purity of the fissile material, as well as the geometry, or the shape, of the assembly.

A nuclear fission is a nuclear reaction in which an atom of fissile material absorbs a neutron causing it to split into two smaller atoms while releasing energy and a few neutrons. The neutrons which are released from the fission reaction are called fast neutrons because of their high energy and velocity. The probability that a fissile isotope's atom can absorb a neutron and fission is much higher if the neutron has a lower energy and velocity. Therefore, systems which are designed to optimize the fission process and sustain criticality (e.g., in a nuclear reactor) include a material called a moderator. A moderator is one or more elements with a relatively low atomic weight, such as hydrogen (water), carbon, and beryllium, which are effective at slowing down the fast neutrons emitted from the fission process. When most fast-fission neutrons collide with moderator atoms, these neutrons lose some of their energy and velocity by transferring this energy to the moderator atom. This process is similar to that of a billiard ball striking one or more other billiard balls after which the striking billiard ball has slowed down.

Critical systems use a reflector outside the fissile isotope. Neutrons produced from fission escape or leak out of the fissile isotope. These lost neutrons cannot contribute to maintaining fission reactions. A reflector is a material which returns many of these escaping neutrons back to the fissile material. Typical reflectors include steel, aluminum, beryllium, copper, and natural uranium.

When the fission chain reaction produces enough neutrons to initiate additional fissions so that this reaction becomes self-sustaining, a condition called criticality is achieved and such a system is critical. The ratio of the neutrons produced in one generation to the neutrons produced in the previous generation is called the neutron multiplication factor, or K_{eff}. For the critical system, the multiplication factor is equal to 1. If the multiplication factor of a system is less than 1, the system is called subcritical, i.e., the fission chain converges (decreases with time) and eventually ends. Conversely, if the multiplication factor is greater than 1, the system is called supercritical, i.e., the fission chain diverges (increases continuously).

Two categories of neutrons are produced from the nuclear fission process: prompt and delayed. Prompt neutrons are emitted instantaneously with the fission event and have a typical lifetime of about 0.00001 seconds. Delayed neutrons are emitted by fission products over a time period of up to approximately one minute after the fissions have occurred. Prompt neutrons constitute over 99 percent of all fission neutrons while delayed neutrons account for approximately 0.2 to 0.7 percent of all fission neutrons depending on which fissile isotope is present. For uranium-235, the delayed neutron fraction is about 0.007, and for plutonium-239 it is about 0.002. A system of fissile material can achieve a critical state using just the prompt neutrons or both the prompt and delayed neutrons. These two conditions are called prompt critical and delayed critical, respectively. On a similar basis, a fissile material system can become prompt supercritical or delayed supercritical. An important difference between these two conditions is that the longer lifetime of delayed neutrons allows a delayed supercritical system to be controlled much more easily than a prompt supercritical system. Typically, a delayed supercritical system increases fission over a time period that allows the mechanical movement of components either to control it or to shut down the fission process. A prompt supercritical system's fission rate increases too rapidly for mechanical movements to be effective. Instead, the system relies on inherent natural behavior such as fissile material temperature rise to reduce the multiplication factor below 1.

The fractional change in the neutron multiplication factor from one neutron generation to the next is known as reactivity. Reactivity is defined by the following expression: $\rho \equiv 1 - 1/K_{eff}$. Reactivity is stated either in terms of percent change in multiplication factor as $\Delta K/K$, or in units of dollars ($) and cents (¢). A dollar reactivity is equal to the delayed neutron fraction—the fraction of all neutrons produced during nuclear fission that is delayed by up to about one minute after the fission occurs. The reactivity cent is one hundredth of a reactivity dollar. The addition of negative reactivity to a critical system results in a subcritical condition. The addition of positive reactivity to a critical system results in a supercritical condition. When a system has a reactivity of exactly one dollar, the system is called prompt-critical. The addition of sufficient positive reactivity to a subcritical system can result in a critical condition. Reactivity can be determined by measuring the change in neutron emission rate over time from an array of fissile material(s).

A fissile material system's multiplication factor can be determined by measuring its neutron generation. This is accomplished by placing a known neutron source inside the fissile material system and measuring the rate of neutrons emanating from the outside surface of the system. The increase in the number of neutrons, called the multiplication factor or M, compared to the number of neutrons emitted by the source can be converted into the system's multiplication factor, K_{eff}, by the formula:

$$K_{eff} = 1- 1/M$$

Thus a system with a neutron multiplication of 100 indicates that its K_{eff}=0.99, (1-1/100).

A.1.1 Flattop

Flattop is located in Building 32 (CASA 2) at TA-18. The Flattop assembly has interchangeable spherical cores of highly enriched uranium [93 percent enriched in uranium-235, denoted as U(93)] metal or plutonium-239 metal, surrounded (during remote operation) by a reflector of thick natural (normal) uranium metal. The reflector is subdivided into a stationary hemisphere, into which the core is recessed, and two movable quadrants. Three natural uranium control rods, one large and two small, enter the stationary hemisphere from below. The large control rod is worth from $1.1 for a uranium-235 core to $1.6 for a plutonium-239 core, and the two small control rods are worth $0.26 for a uranium-235 core to $0.4 for a plutonium-239 core. Upon shutdown, also called scram, both quadrants of the reflector retract rapidly to the normal "disassembled" condition. Flattop is used for fundamental reactor physics studies and, by irradiation in the known neutron spectra, to provide samples for radiochemical research. **Figure A–1** and **Figure A–2** show the general structure of Flattop. Flattop is approximately 2.4 × 1.8 × 1.5 meters (8 × 6 × 5 feet) in size and operates at a low average power without the need for external cooling.

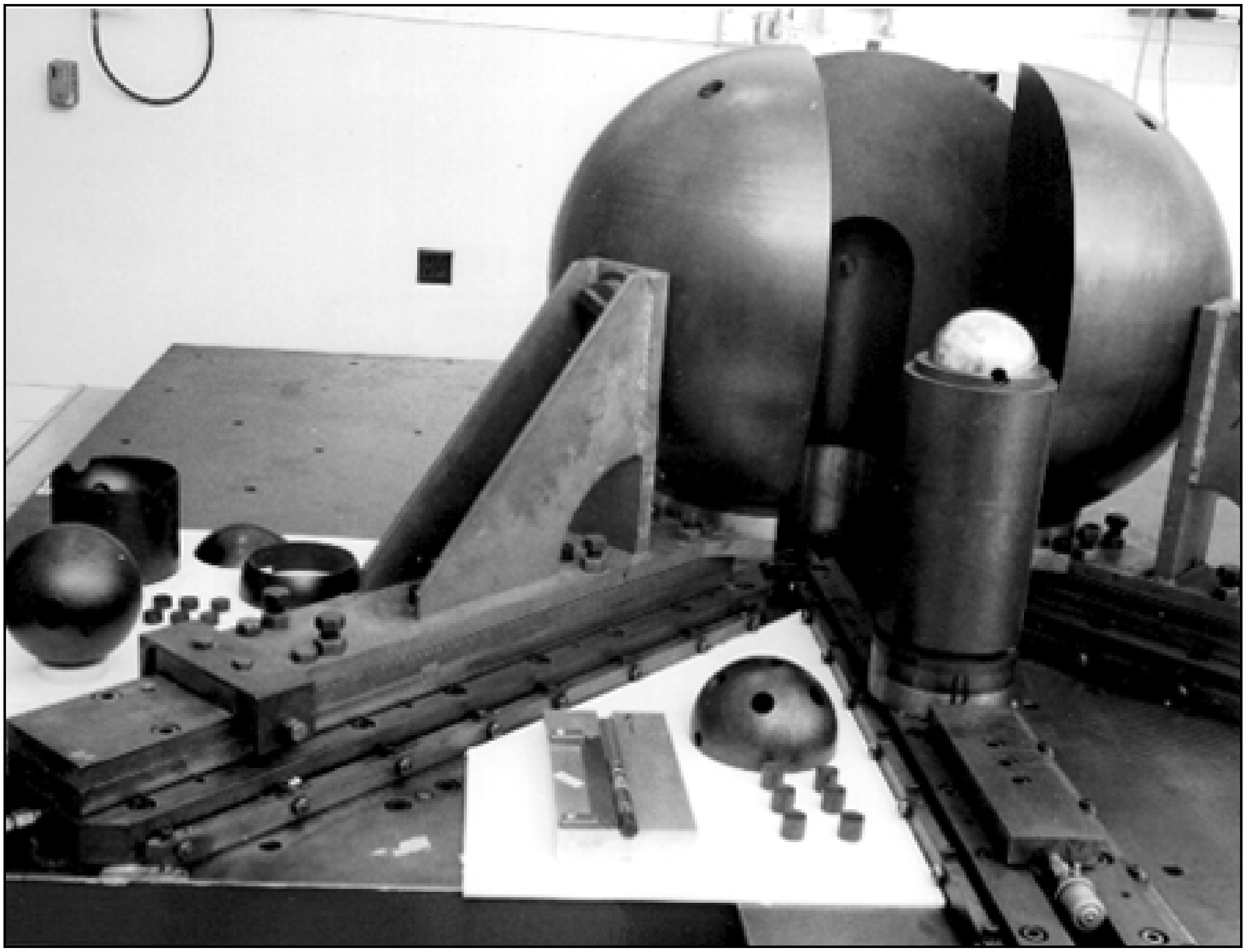

Figure A–1 Flattop Benchmark Assembly

Figure A–2 shows a schematic of a typical Flattop assembly. It consists of a core (a sphere) of fissile material at the center of a sphere of a natural uranium reflector (made out of three blocks). The core is supported on its own natural uranium pedestal, which is mounted on a keyed track with manual control for positioning the assembled core in the stationary hemisphere of a natural uranium reflector. Closure of the movable reflector quarter spheres (quadrants), known as safety block A and B, and insertion of the control rods are done remotely from the control room. The scram action (shutdown mechanism) causes the quarter-sphere safety blocks to disassemble and retract at a graded rate. The initial separation, in the first centimeter (0.4 inches), provides a reactivity withdrawal of $2.3 per block. Then the rate at which the safety blocks separate would be one tenth of the speed during the first separation. These blocks are operated by an Alternating current (Ac)-driven hydraulic pressure system, backed by two independent nitrogen gas accumulators to ensure positive scram in the event of loss of electrical power. The control rod drives are Ac-powered and do not require loss-of-power backup.

A horizontal hole (known as a glory hole) through the center of the stationary hemisphere reflector and the core provides access for irradiation samples and detectors to the central zone of the assembly. The pedestal where the fissile core sits contains many voids (cavities) that may be filled with either natural uranium or highly enriched uranium buttons to compensate for the various glory hole configurations.

The uranium and plutonium core masses (without the mass adjustment buttons and glory pieces) weigh 18 and 6 kilograms (39.7 and 13.2 pounds), respectively. The addition of mass adjustment buttons is insufficient to exceed the critical mass for the unreflected core. The cores are stored in the CASA 2 vault

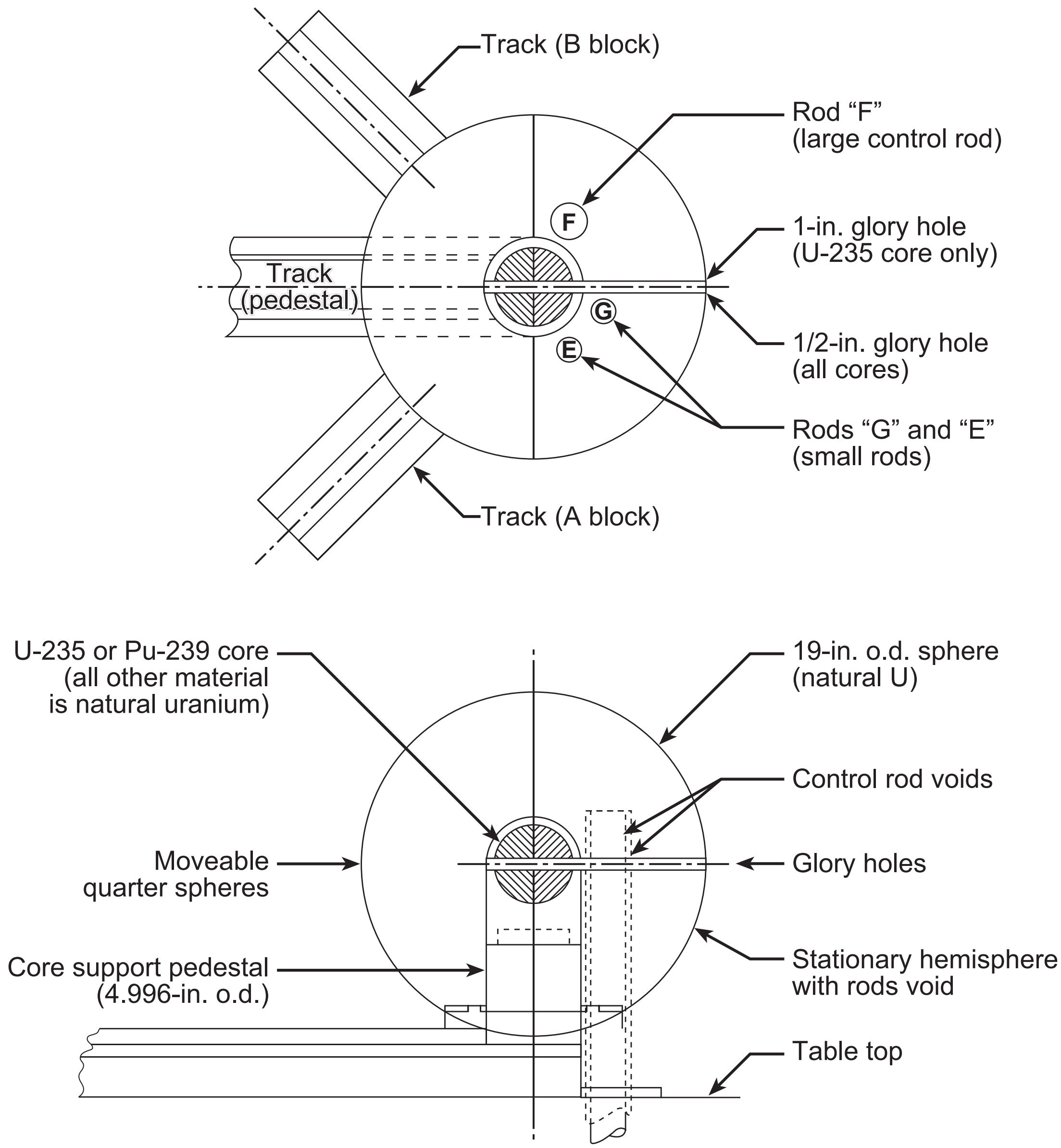

Figure A–2 Schematic of Flattop Assembly

in a criticality safe configuration when Flattop is not operating. The plutonium core is stored in heat sinks to dissipate heat from spontaneous fission decay of plutonium-240 (which constitutes about 5 percent of the total plutonium).

A.1.2 Godiva

Godiva is a fast-burst assembly with a fuel mass of 65.4 kilograms (144 pounds) of highly enriched uranium. Godiva is the fourth in a series of basically bare, unreflected, fast-burst assemblies with similar characteristics. Godiva is primarily an irradiation assembly, although its original purpose was to test design features, including material selection, that are expected to increase resistance to shock damage. The

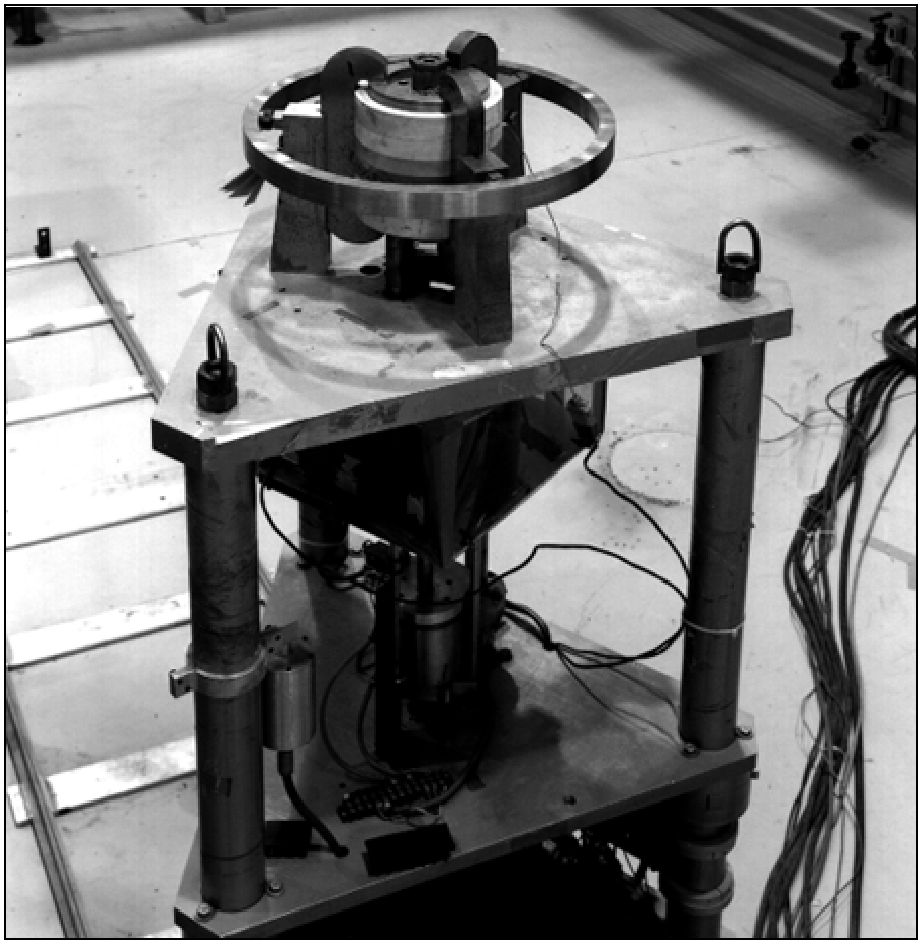

Figure A–3 Godiva (shown without optional cover)

assembly has fixed core components and a permanent structural base, (see **Figure A–3**). The entire Godiva assembly is approximately 0.90 × 1.2 × 3 meters (3 × 4 × 10 feet) tall in size. It is secured in a special vault in TA-18 Building 116 (CASA 3), and is moved on aluminum tracks from the vault to the test area. Power, control, and instrumentation circuits for Godiva are provided by an umbilical panel that physically attaches to the machine. After the test, this panel is removed by remote activation. A winch cable attached to the assembly cart is actuated, pulling the assembly into the vault. The vault door is closed and locked by command from the control room.

Figure A–4 shows the Godiva fuel components and support system. The Godiva fuel is enriched uranium alloyed with 1.5 percent molybdenum by weight. Fuel components are all aluminum-ion plated. Three external C-shaped clamps fabricated from high performance maraging steel fasten the stack of fuel component rings. The five major uranium-molybdenum alloy subsections of Godiva (stationary head and movable safety block and three control rods [two shim rods and one burst rod]) form an essentially unreflected cylinder when brought together remotely. Delayed criticality is attained when the safety block is inserted by adjustment of two uranium control rods (each worth about $1.5) that enter the head. From this state, a burst may be produced by sudden insertion of an interlocked U(93) burst rod with a reactivity worth of about $1, allowing a further adjustment of control-rod position. Thermal expansion of the fuel components produces a shock which terminates the burst. The safety block is threaded onto a stainless steel support mandrel at the lower end of the core so that thermal expansion exerts a downward thrust on the support shaft, opening a magnetic clutch to provide shock-induced trip. The production of a burst of known magnitude involves a well-defined cycle including a delayed critical check, retraction of the safety block to allow delay of the neutron population, and control adjustment to trim excess reactivity as required for the desired burst while allowing for temperature drift, reinsertion of the safety block, and burst-rod insertion. Interlocks prevent major departures from this cycle. The burst actuates a scram signal, which deactivates a magnet that normally secures the safety block and ejects the burst rod.

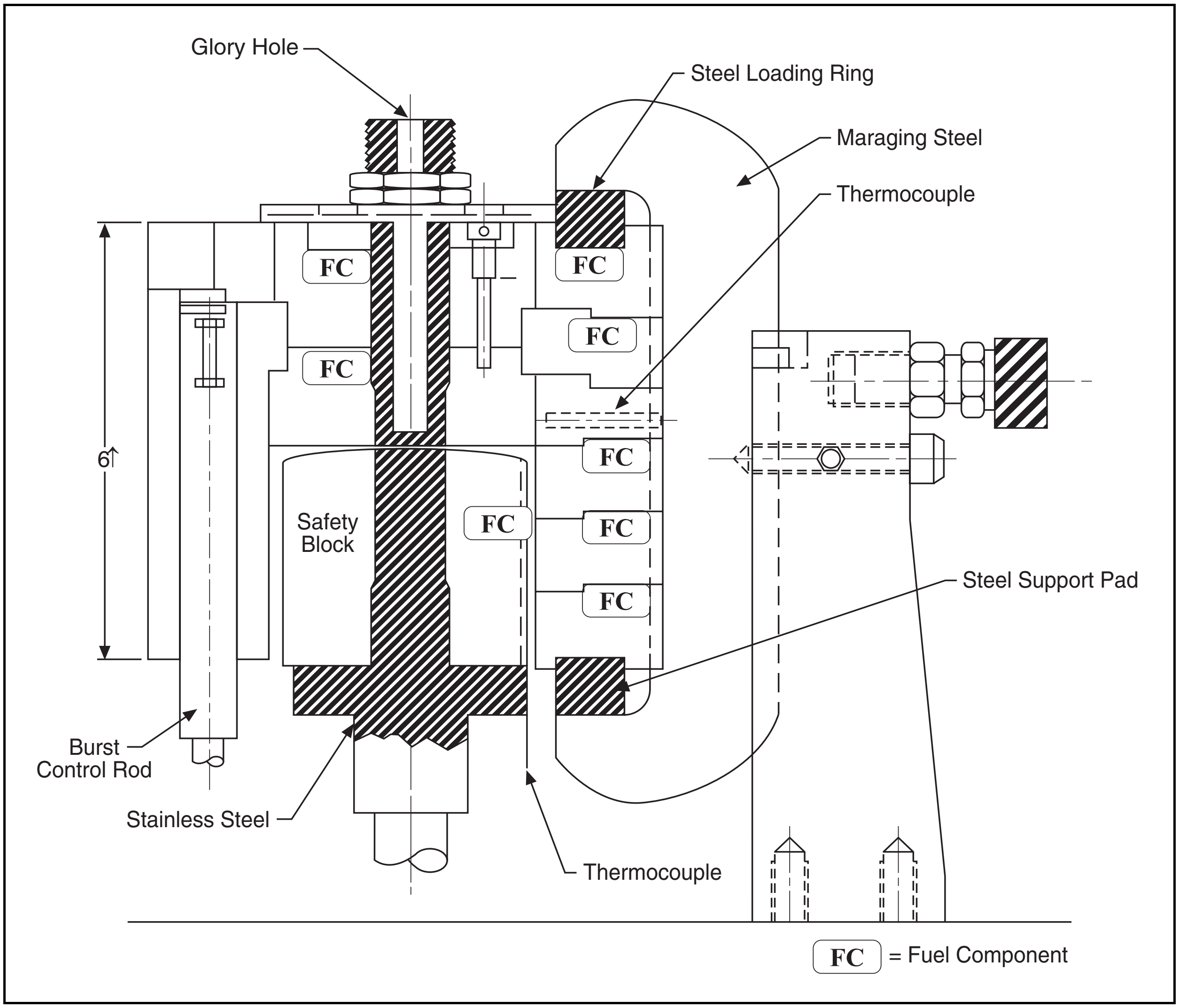

Figure A–4 Godiva Fuel Components and Support System

A.1.3 Comet

The Comet general-purpose assembly machine is a vertical lift platform located in TA-18 CASA 2, (see **Figure A–5**). The machine is designed to accommodate a wide variety of experiments in which neutron multiplication is measured as a function of separation distance between experiment components. The Comet machine may be used for criticality safety training on approach-to-critical. The Comet configuration is split into two parts, one of which is mounted in a stationary position (upper structure), while the other is located on a movable platen. The movable part of the experiment occurs in two discrete steps: actuation of a hydraulic lift and completion of motion by a stepping motor (fine adjustment). The entire assembly is 1.2 × 1.2 × 3.6 meters (4 × 4 × 12 feet) in size with its reflector in place. **Figure A–6** shows a schematic of the Comet assembly machine without reflector.

The current fuel configuration uses unclad enriched uranium circular plates approximately 0.31 centimeters (0.125 inches) thick, separated by plates of graphite approximately 1 centimeter (0.39 inches) thick. Proposed future fuel for the present experiment may include plutonium plates with a total mass of about 200 kilograms (441 pounds) or other fuel elements. Configurations may also include other geometric combinations of fissile material and interstitial materials. The Comet reflector, like the fuel, can be arranged

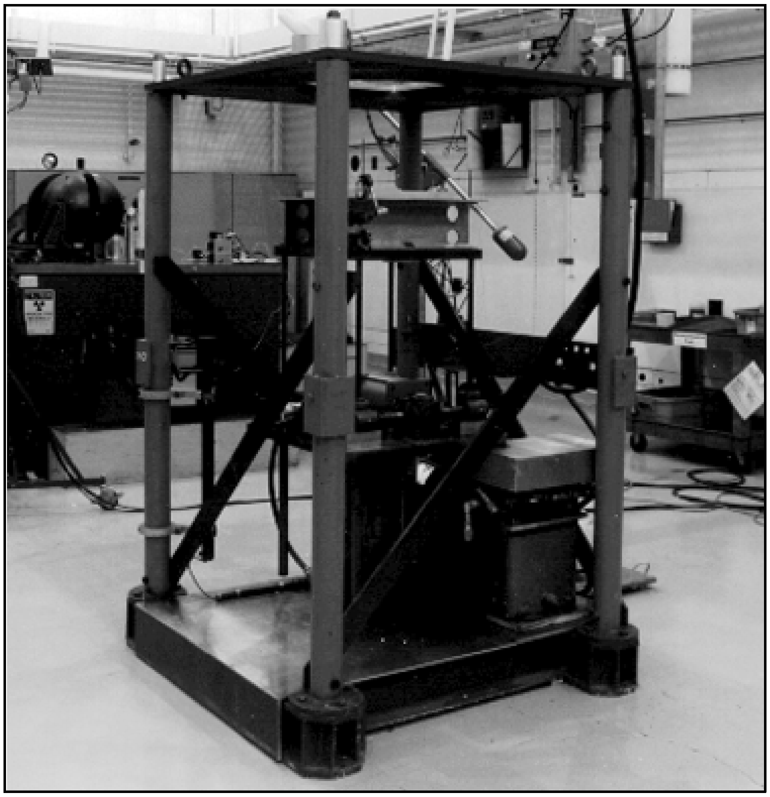

Figure A–5 Comet Assembly Machine

in various configurations. The current configuration consists of an upper region containing approximately 6,350 kilograms (14,000 pounds) of copper assembled in blocks surrounding the upper fuel components. The height of the reflector is approximately 1.2 meters (47 inches) on a 0.91-meter (34-inch) base.

Comet is designed to approach or reach the condition of criticality as the lower assembly nears the upper stationary assembly. This is accomplished by first raising the movable platen hydraulically, followed by a stepper motor drive for precision positioning of the lower assembly. Nuclear operations with Comet are first supported with detailed calculations of the proposed assembly. As material (fissile and interstitial) is stacked, but well before a critical configuration, careful measurements of the partially assembled mass are taken to verify that excessive reactivity is not present. The fuel materials which can be used in Comet include uranium, plutonium, and neptunium. Test quantities can exceed 200 kilograms (441 pounds) of fissile material. Under normal scrams, both the hydraulic ram and the stepper motor move to the least reactive conditions (initial positions). Under loss of power, the valve for the hydraulic ram switches to the down position causing the hydraulic ram to move down. This downward motion is caused by gravity and assisted by a pressure accumulator in the hydraulic system.

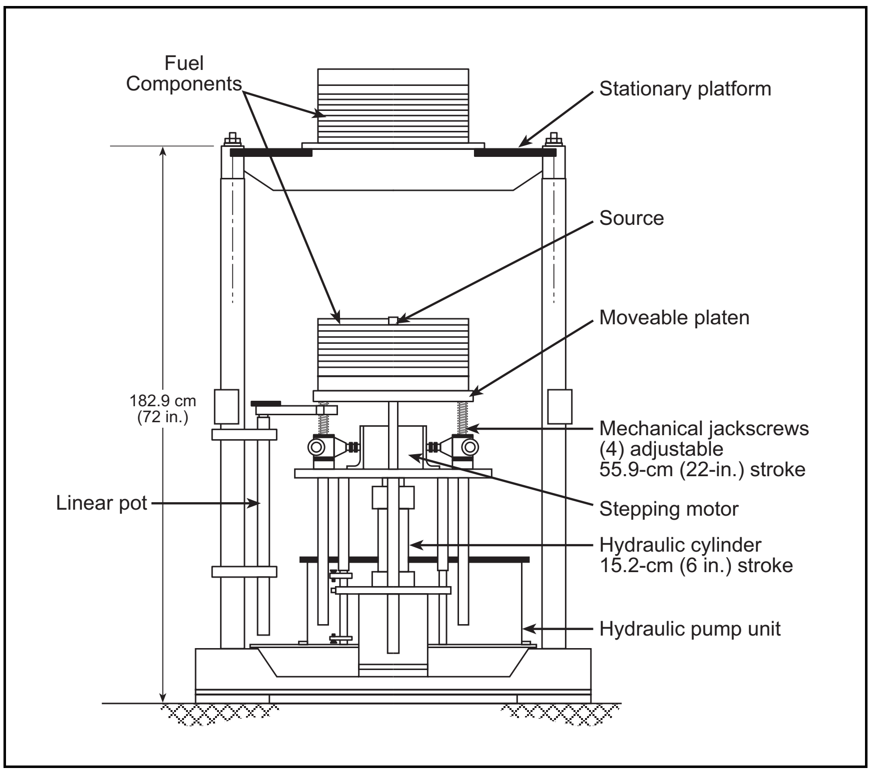

Figure A–6 Comet (shown without reflector)

A.1.4 Planet

Planet is a general-purpose, portable vertical assembly machine located in TA-18 CASA 1. Like Comet, the Planet machine uses a moveable table powered by hydraulic lift with movable platen powered by a stepping motor. A fixed (stationary) platform is mounted above the table and platen assembly. The steel frame is mounted on casters/wheels and is not rigidly attached to the CASA structure. There are retractable feet to hold the Planet in place. The planet machine has two features not found on the Comet machine: (1) a remotely adjustable positive stop on the hydraulic lift up-limit and (2) mechanical stops on the platen up-limit. The entire assembly is similar to that of Comet, i.e., 1.2 × 1.2 × 3.6 meters (4 × 4 × 12 feet) in size. **Figure A–7** illustrates the physical set up of Planet in a special criticality experiment arrangement.

Planet is used to investigate the criticality characteristics of different geometries and compositions. Both heterogeneous and homogeneous arrangements of fissile materials with different types and quantities of moderator materials can be used. Its past use includes experiments to evaluate the criticality of slab tanks filled with liquid solutions of highly enriched uranyl nitrate to simulate storage tanks at a proposed reprocessing facility.

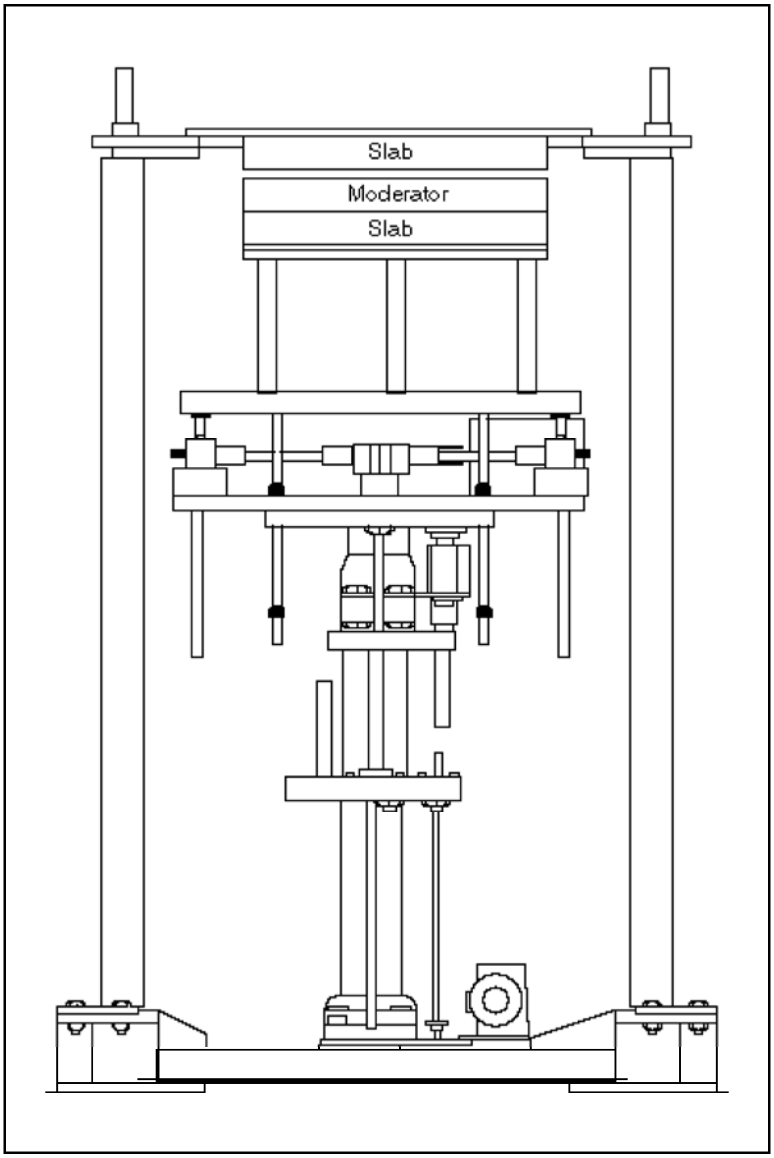

Figure A–7 Planet (in a Special Experimental Arrangement)

A hydraulic ram is the primary scram device for removing reactivity from critical assemblies on the Planet machine. Given a scram signal, the hydraulic system valves are de-energized in a manner that allows the ram to descend at a fairly rapid rate (i.e., gravity-assisted), and the stepping motor also drives the platen downward. In the event of loss of power, the hydraulic valves open to allow the ram to move down under the force of gravity. This downward movement separates the two critical-assembly segments, thereby stopping the criticality process.

Currently, one basic core type is used in Planet. The core consists of laminated foils containing 93 percent enriched uranium-235, interspersed with a variety of interstitial materials. This core loading is used in a criticality experiment performed monthly as part of the Nuclear Criticality Safety Course conducted at the Los Alamos National Laboratory (LANL). In addition, it is currently used to evaluate issues including the design of repositories for long-term disposal of nuclear materials. In the future, Planet may be fueled with weapons-grade plutonium (approximately 7 kilograms [15 pounds]), and/or with about 50 kilograms (110 pounds) of highly enriched uranium using cryogenic materials to achieve low temperatures.

A.1.5 Solution High-Energy Burst Assembly

SHEBA is operated in TA-18 Building 168 (SHEBA building). It is a simple, unreflected, fissile solution critical assembly vessel that is controlled by adding or removing solution. It was designed especially for proof testing criticality accident detection systems (see **Figure A–8** and **Figure A–9**). The detectors for criticality accident alarms were calibrated by fast-neutron leakage pulses from Godiva-like reactors (solid metal critical assemblies), whereas the majority of criticality accidents have occurred in solutions. As a thermal spectrum assembly, SHEBA generates relatively slow leakage neutrons such as those emitted by critical solutions. Fueled with either an aqueous solution of low-enriched (about 5 percent uranium-235) uranyl fluoride [$U0_2F_2$] or a solution of up to 20 percent uranium-235 enriched uranyl nitrate. SHEBA fuel requires a moderator to achieve criticality; the moderator is integral with the fuel because the fuel is a water-based solution. The critical mass of uranium-235 in SHEBA is about 4.1 kilograms (9 pounds). SHEBA is installed in a sheet metal building outside TA-18 Building 23 (CASA 1). Criticality is attained by solution-height adjustment in the critical assembly vessel whose inside diameter measures 48.9 centimeters (19.25 inches).

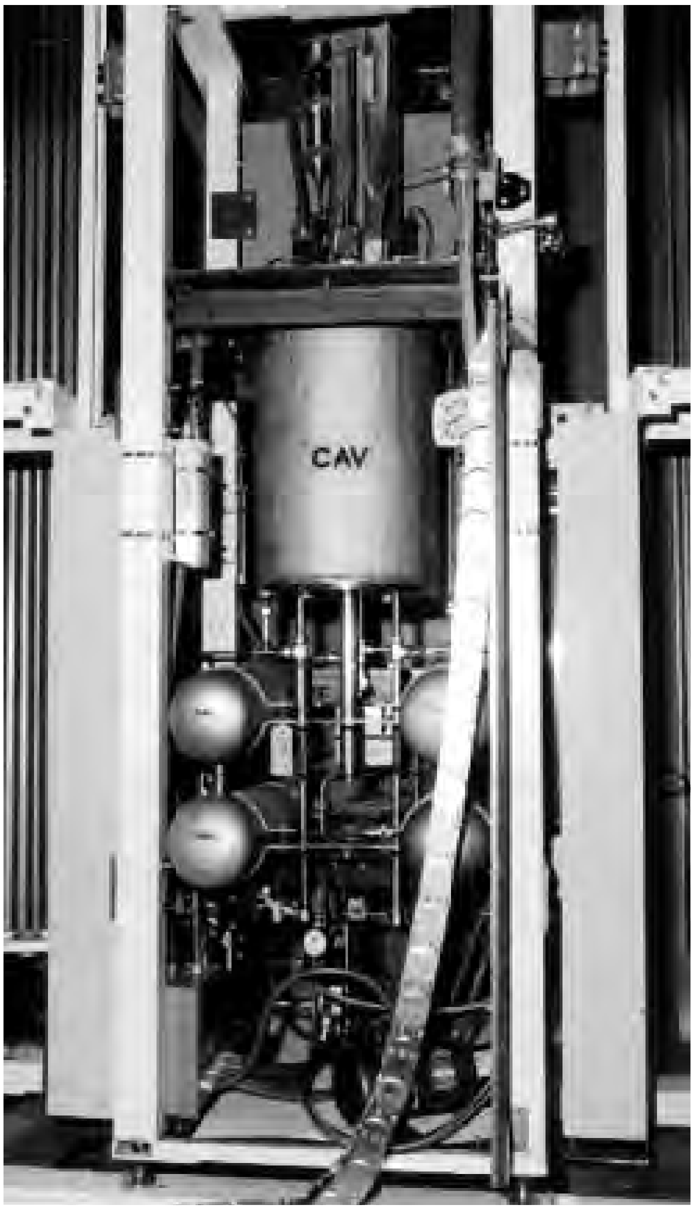

Figure A–8 SHEBA Machine

Major equipment at SHEBA includes the critical assembly vessel, four fuel storage tanks, a pumped-fuel fill system, a gravity fuel drain system, a flowing nitrogen cover gas system, and a safety rod system. The fuel solution is initially stored in four criticality-safe, stainless steel tanks. The solution is transferred to the critical assembly vessel by an AC-driven fuel feed pump. The critical assembly vessel and the storage tanks are equipped with heating and cooling jackets to maintain the solution temperature at a desired level. The jackets are attached to the building chiller system.

The nitrogen cover gas system sweeps the fission product and radiolytic gases into holding tanks after passing them through a catalytic recombiner. In the holding tanks the fission gases are allowed to decay under confinement before release. The catalytic converter recombines the radiolytic gas to maintain a noncombustible atmosphere in the holding tanks. The design pressure of the critical assembly vessel is 1.03 megapascals (150 pounds per square inch).

Shutdown is achieved by rapid draining of the uranium solution into storage cylinders. Upon scram signal, two independent scram (drain) valves open, allowing gravity draining of the fuel solution. A pneumatically operated safety rod that can drop into a 6.35-centimeter (2.5-inch)-diameter axial tube inside the critical assembly vessel is also provided as a supplement to the rapid draining shutdown process.

SHEBA has been used principally to assess and calibrate criticality accident dosimeters for a uranium enrichment plant. In addition, the assembly is used for general-purpose critical experiments and studies of the behavior of nuclear excursions in a low-enriched solution medium. It has also served as a source for skyshine (radiation scattering in air) measurements. SHEBA can also be used as training tool as part of a nuclear criticality safety class.

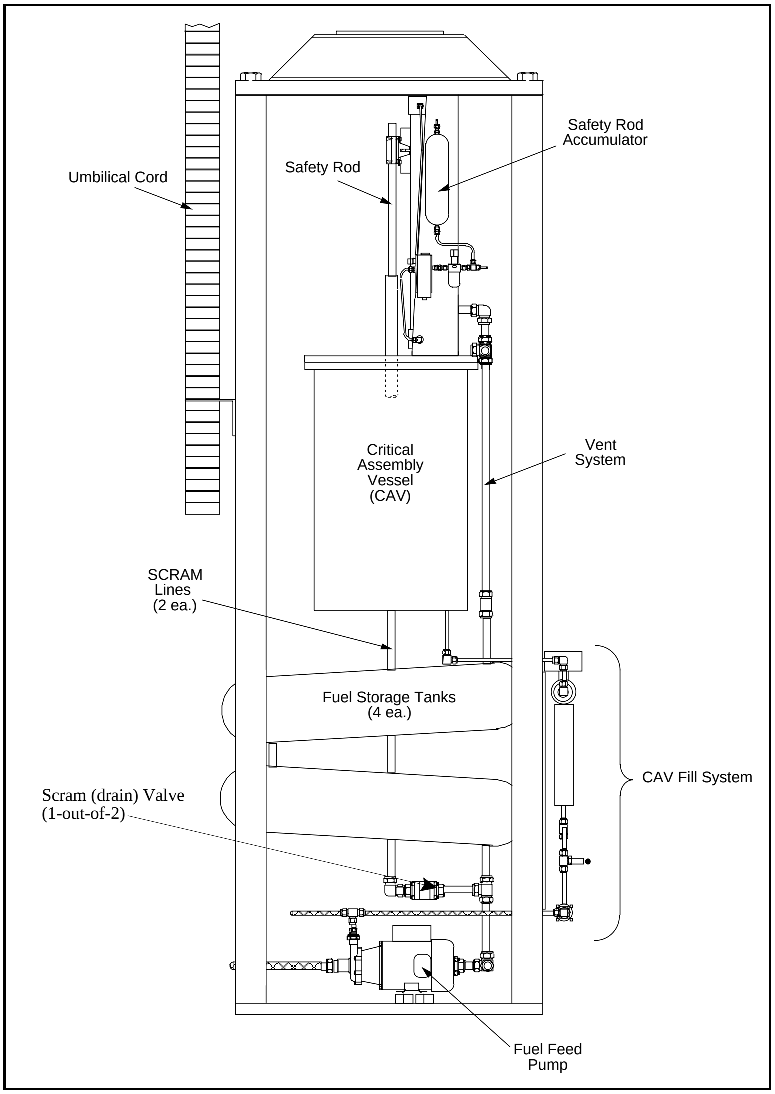

Figure A–9 Schematic of SHEBA

A.2 References

DOE (U.S. Department of Energy), 2001, *Basis for Interim Operations for the Los Alamos Critical Experiments Facility (LACEF), and Hillside Vault (PL-26)*, Los Alamos, New Mexico, May.

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APPENDIX B

Human Health Effects from Normal Operations

APPENDIX B
HUMAN HEALTH EFFECTS FROM NORMAL OPERATIONS

B.1 INTRODUCTION

This appendix provides a brief general discussion on radiation and its health effects. It also describes the methods and assumptions used for estimating the potential impacts and risks to individuals and the general public from exposure to releases of radioactivity during normal operations and postulated accidents at facilities used to perform TA-18 missions.

This appendix presents numerical information using engineering and/or scientific notation. For example, the number 100,000 also can be expressed as 1×10^5. The fraction 0.001 also can be expressed as 1×10^{-3}. The following chart defines the equivalent numerical notations that may be used in this appendix.

FRACTIONS AND MULTIPLES OF UNITS

Multiple	*Decimal Equivalent*	*Prefix*	*Symbol*
1×10^6	1,000,000	mega-	M
1×10^3	1,000	kilo-	k
1×10^2	100	hecto-	h
1×10	10	deka-	da
1×10^{-1}	0.1	deci-	d
1×10^{-2}	0.01	centi-	c
1×10^{-3}	0.001	milli-	m
1×10^{-6}	0.000001	micro-	μ

B.2 RADIOLOGICAL IMPACTS ON HUMAN HEALTH

Radiation exposure and its consequences are topics of interest to the general public. For this reason, this environmental impact statement (EIS) places emphasis on the consequences of exposure to radiation, provides the reader with information on the nature of radiation, and explains the basic concepts used in the evaluation of radiation health effects.

B.2.1 Nature of Radiation and Its Effects on Humans

What Is Radiation?

Radiation is energy transferred in the form of particles or waves. Globally, human beings are exposed constantly to radiation from the solar system and the Earth's rocks and soil. This radiation contributes to the natural background radiation that always surrounds us. Manmade sources of radiation also exist, including medical and dental x-rays, household smoke detectors, and materials released from nuclear and coal-fired power plants.

All matter in the universe is composed of atoms. Radiation comes from the activity of tiny particles within an atom. An atom consists of a positively charged nucleus (central part of an atom) with a number of negatively charged electron particles in various orbits around the nucleus. There are two types of particles in the nucleus: neutrons that are electrically neutral and protons that are positively charged. Atoms of different types are known as elements. There are more than 100 natural and manmade elements. An element has equal numbers of electrons and protons. When atoms of an element differ in their number of neutrons, they are called isotopes of that element. All elements have three or more isotopes, some or all of which could be unstable (i.e., decay with time).

Unstable isotopes undergo spontaneous change, known as radioactive disintegration or radioactive decay. The process of continuously undergoing spontaneous disintegration is called radioactivity. 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. An isotope's half-life is a measure of its decay rate. For example, an isotope with a half-life of eight days will lose one-half of its radioactivity in that amount of time. In eight more days, one-half of the remaining radioactivity will be lost, and so on. 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 unstable isotopes change into more stable forms, they emit electrically charged particles. These particles may be either an alpha particle (a helium nucleus) or a beta particle (an electron), with various levels of kinetic energy. Sometimes these particles are emitted in conjunction with gamma rays. The alpha and beta particles are frequently referred to as ionizing radiation. Ionizing radiation refers to the fact that the charged particle energy force can ionize, or electrically charge, an atom by stripping off one of its electrons. Gamma rays, even though they do not carry an electric charge as they pass through an element, can ionize its atoms by ejecting electrons. Thus, they cause ionization indirectly. Ionizing radiation can cause a change in the chemical composition of many things, including living tissue (organs), which can affect the way they function.

When a radioactive isotope of an element emits a particle, it changes to an entirely different element, one that may or may not be radioactive. Eventually a stable element is formed. This transformation, which may take several steps, is known as a decay chain. For example, radium, which is a member of the radioactive decay chain of uranium, has 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 first to polonium, then through a series of further decay steps to bismuth, and ultimately to a stable isotope of lead. Meanwhile, the decay products will build up and eventually die away as time progresses.

The characteristics of various forms of ionizing radiation are briefly described below and in the box at right (see Chapter 8 for further definitions):

Radiation Type	Typical Travel Distance in Air	Barrier
α	Few centimeters	Sheet of paper or skin's surface
β	Few meters	Thin sheet of aluminum foil or glass
γ	Very large	Thick wall of concrete, lead, or steel
n	Very large	Water, paraffin, graphite

Alpha (α)—Alpha particles are the heaviest type of ionizing radiation. They can travel only a few centimeters in air. Alpha particles lose their energy almost as soon as they collide with anything. They can be stopped easily by a sheet of paper or by the skin's surface.

Beta (β)—Beta particles are much (7,330 times) lighter than alpha particles. They can travel a longer distance than alpha particles in the air. A high-energy beta particle can travel a few meters in the air. Beta particles can pass through a sheet of paper, but may be stopped by a thin sheet of aluminum foil or glass.

Gamma (γ)—Gamma rays (and x-rays), unlike alpha or beta particles, are waves of pure energy. Gamma rays travel at the speed of light. Gamma radiation is very penetrating and requires a thick wall of concrete, lead, or steel to stop it.

Neutrons (n)—Neutrons are particles that contribute to radiation exposure both directly and indirectly. The most prolific source of neutrons is a nuclear reactor. Indirect radiation exposure occurs when gamma rays and alpha particles are emitted following neutron capture in matter. A neutron has about one-quarter the weight of an alpha particle. It will travel in the air until it is absorbed in another element.

Units of Radiation Measure

During the early days of radiological experience, there was no precise unit of radiation measure. Therefore, a variety of units were used to measure radiation. These units were used to determine the amount, type, and intensity of radiation. Just as heat can be measured in terms of its intensity or effects using units of calories or degrees, amounts of radiation or its effects can be measured in units of curies, radiation absorbed dose (rad), or dose equivalent (roentgen equivalent man, or rem). The following summarizes those units (see also the definitions in Chapter 8).

Curie—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 was the basis of this unit of measure. Because the measured decay rate kept changing slightly as measurement techniques became more accurate, the curie was subsequently defined as exactly 3.7×10^{10} disintegrations (decays) per second.

Rad—The rad is the unit of measurement for the physical absorption of radiation. The total energy absorbed per unit quantity of tissue is referred to as absorbed dose (or simply dose). As sunlight heats pavement by giving up an amount of energy to it, radiation similarly gives up 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 of absorbing material.

Radiation Units and Conversions to International System of Units

1 curie = 3.7×10^{10} disintegrations per second
= 3.7×10^{10} becquerels
1 becquerel = 1 disintegration per second
1 rad = 0.01 gray
1 rem = 0.01 sievert
1 gray = 1 joule per kilogram

Rem—A rem is a measurement of the dose equivalent from radiation based on its biological effects. The rem is used in measuring the effects of radiation on the body as degrees centigrade are used in measuring 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 kind of radiation. This allows comparison of the biological effects of radionuclides that emit different types of radiation.

The units of radiation measure in the International System of Units are: becquerel (a measure of source intensity [activity]), gray (a measure of absorbed dose), and sievert (a measure of dose equivalent).

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

Sources of Radiation

The average American receives a total of approximately 360 millirem per year from all sources of radiation, both natural and manmade, of which approximately 300 millirem per year are from natural sources. The sources of radiation can be divided into six different categories: (1) cosmic radiation, (2) terrestrial radiation, (3) internal radiation, (4) consumer products, (5) medical diagnosis and therapy, and (6) other sources (NCRP 1987). These categories are discussed in the following paragraphs.

Cosmic Radiation—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 comprise cosmic radiation. Because the atmosphere provides some shielding against cosmic radiation, the intensity of this radiation increases with the altitude above sea level. The average dose to people in the United States from this source is approximately 27 millirem per year.

External Terrestrial Radiation—External terrestrial radiation is the radiation emitted from the radioactive materials in the Earth's rocks and soils. The average dose from external terrestrial radiation is approximately 28 millirem per year.

Internal Radiation—Internal radiation results 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 contributor to the annual dose equivalent for internal radioactivity is the short-lived decay products of radon, which contribute approximately 200 millirem per year. The average dose from other internal radionuclides is approximately 39 millirem per year.

Consumer Products—Consumer products also contain sources of ionizing radiation. In some products, such as smoke detectors and airport x-ray machines, the radiation source is essential to the product's operation. In other products, such as televisions and tobacco, the radiation occurs as the products function. The average dose from consumer products is approximately 10 millirem per year.

Medical Diagnosis and Therapy—Radiation is an important diagnostic medical tool and cancer treatment. Diagnostic x-rays result in an average exposure of 39 millirem per year. Nuclear medical procedures result in an average exposure of 14 millirem per year.

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

Exposure Pathways

As stated earlier, an individual may be exposed to ionizing radiation both externally and internally. The different ways that could result in radiation exposure to an individual are called exposure pathways. Each type of exposure is discussed separately in the following paragraphs.

External Exposure—External exposure can result from several different pathways, all having in common the fact that the radiation causing the exposure is external to the body. These pathways include exposure to a cloud of radiation passing over the receptor (i.e., an individual member of the public), standing on ground that is contaminated with radioactivity, and swimming or boating in contaminated water. If the receptor departs from the source of radiation exposure, the dose rate will be reduced. It is assumed that external exposure occurs uniformly during the year. The appropriate dose measure is called the effective dose equivalent.

Internal Exposure—Internal exposure results from a radiation source entering the human body through either inhalation of contaminated air or ingestion of contaminated food or water. In contrast to external exposure, once a radiation source enters the body, it remains there for a period of time that varies depending on decay and biological half-life. The absorbed dose to each organ of the body is calculated for a period of 50 years following the intake. The calculated absorbed dose is called the committed dose equivalent. Various organs have different susceptibilities to harm from radiation. The quantity that takes these different susceptibilities into account is called the committed effective dose equivalent, and it provides a broad indicator of the risk to the health of an individual from radiation. The committed effective dose equivalent is a weighted sum of the committed dose equivalent in each major organ or tissue. The concept of committed effective dose equivalent applies only to internal pathways.

Radiation Protection Guides

Various organizations have issued radiation protection guides. The responsibilities of the main radiation safety organizations, particularly those that affect policies in the United States, are summarized below.

International Commission on Radiological Protection—This Commission has the responsibility for providing guidance in matters of radiation safety. The operating policy of this organization is to prepare recommendations to deal with basic principles of radiation protection and to leave to the various national protection committees the responsibility of introducing the detailed technical regulations, recommendations, or codes of practice best suited to the needs of their countries.

National Council on Radiation Protection and Measurements—In the United States, this Council is the national organization that has the responsibility for adapting and providing detailed technical guidelines for implementing the International Commission on Radiological Protection recommendations. The Council consists of technical experts who are specialists in radiation protection and scientists who are experts in disciplines that form the basis for radiation protection.

National Research Council/National Academy of Sciences—The National Research Council is an organization within the National Academy of Sciences that associates the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the Federal Government.

Environmental Protection Agency—The Environmental Protection Agency (EPA) has published a series of documents, *Radiation Protection Guidance to Federal Agencies*. This guidance is used as a regulatory benchmark by a number of Federal agencies, including the U.S. Department of Energy (DOE), in the realm of limiting public and occupational work force exposures to the greatest extent possible.

Limits of Radiation Exposure

Limits of exposure to members of the public and radiation workers are derived from International Commission on Radiological Protection recommendations. The EPA uses the National Council on Radiation Protection and Measurements and the International Commission on Radiological Protection recommendations and sets specific annual exposure limits (usually less than those specified by the Commission) in *Radiation Protection Guidance to Federal Agencies* documents. Each regulatory organization then establishes its own set of radiation standards. The various exposure limits set by DOE and the EPA for radiation workers and members of the public are given in **Table B–1**.

Table B–1 Exposure Limits for Members of the Public and Radiation Workers

Guidance Criteria (Organization)	*Public Exposure Limits at the Site Boundary*	*Worker Exposure Limits*
10 CFR 835 (DOE)	—	5,000 millirem per year [a]
10 CFR 835.1002 (DOE)	—	1,000 millirem per year [b]
DOE Order 5400.5 (DOE) [c]	10 millirem per year (all air pathways) 4 millirem per year (drinking water pathway) 100 millirem per year (all pathways)	—
40 CFR 61 (EPA)	10 millirem per year (all air pathways)	—
40 CFR 141 (EPA)	4 millirem per year (drinking water pathways)	—

[a] Although this is a limit (or level) which is enforced by DOE, worker doses must still adhere to as low as is reasonably achievable principles. Refer to footnote b.

[b] This is a control level. It was established by DOE to assist in effecting its goal to maintain radiological doses as low as is reasonably achievable. DOE recommends that facilities adopt a more limiting 500 millirem per year Administrative Control Level (DOE 1999b). Reasonable attempts have to be made by the site to maintain individual worker doses below these levels.

[c] Derived from 40 CFR 61, 40 CFR 141, and 10 CFR 20.

B.2.2 Health Effects

Radiation exposure and its consequences are topics of interest to the general public. To provide the background for discussions of impacts, this section explains the basic concepts used in the evaluation of radiation effects.

Radiation can cause a variety of damaging health effects in people. The most significant effects are induced cancer fatalities. These effects are referred to as “latent” cancer fatalities because the cancer may take many years to develop. In the discussions that follow, all fatal cancers are considered latent; therefore, the term “latent” is not used.

The National Research Council’s Committee on the Biological Effects of Ionizing Radiation (BEIR) has prepared a series of reports to advise the U.S. Government on the health consequences of radiation exposures. *Health Effects of Exposure to Low Levels of Ionizing Radiation*, BEIR V (National Research Council 1990), provides the most current estimates for excess mortality from leukemia and other cancers that are expected to result from exposure to ionizing radiation. BEIR V provides estimates that are consistently higher than those in its predecessor, BEIR III. This increase 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 associated others. BEIR III employs constant, relative, and absolute risk models, with separate coefficients for each of several sex and age-at-exposure groups. 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. The BEIR III models were based on the assumption that absolute risks are comparable between the atomic bomb survivors and the U.S. population. 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 that included the Japanese atomic bomb survivors, ankylosis spondylitis patients, Canadian and Massachusetts fluoroscopy (breast cancer) patients, New York postpartum mastitis (breast cancer) patients, Israeli tinea capitis (thyroid cancer) patients, and Rochester thymus (thyroid cancer) patients. 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 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.

The National Council on Radiation Protection and Measurements (NCRP 1993), based on the radiation risk estimates provided in BEIR V and the International Commission on Radiological Protection Publication 60 recommendations (ICRP 1991), has estimated the total detriment resulting from low dose[1] or low dose rate exposure to ionizing radiation to be 5.6×10^{-4} per rem for the working population and 7.3×10^{-4} per rem for the general population. The total detriment includes fatal and nonfatal cancer which is severe hereditary (genetic) effects. The major contribution to the total detriment is from fatal cancer which is estimated to be 4×10^{-4} and 5×10^{-4} per rem for radiation workers and the general population, respectively. The breakdowns of the risk estimators for both workers and the general population are given in **Table B–2**. Nonfatal cancers and genetic effects are less probable consequences of radiation exposure. To simplify the presentation of the impacts, estimated effects of radiation are calculated only in terms of cancer fatalities. For higher doses to an individual (20 rem or more), as could be associated with postulated accidents, the risk estimators given in Table B–2 are doubled.

Table B–2 Nominal Health Risk Estimators Associated with Exposure to 1 Rem of Ionizing Radiation

Exposed Individual	*Fatal Cancer* [a, c]	*Nonfatal Cancer* [b]	*Genetic Disorders* [b]	*Total*
Worker	.0004	.00008	.00008	.0005
Public	.0005	.0001	.00013	.00073

[a] For fatal cancer, the health effect coefficient is the same as the probability coefficient. When applied to an individual, the units are the lifetime probability of a cancer fatality per rem of radiation dose. When applied to a population of individuals, the units are the excess number of fatal cancers per person-rem of radiation dose.

[b] In determining a means of assessing health effects from radiation exposure, the International Commission on Radiological Protection has developed a weighting method for nonfatal cancers and genetic effects.

[c] For high individual exposures (greater than or equal to 20 rem), the health factors are multiplied by a factor of 2.

Source: NCRP 1993.

The numerical estimates of fatal cancers presented in this EIS were obtained using a linear extrapolation from the nominal risk estimated for lifetime total cancer mortality that results from a dose of 0.1 gray (10 rad). Other methods of extrapolation to the low-dose region could yield higher or lower numerical estimates of fatal cancers. Studies of human populations exposed to low doses are inadequate to demonstrate the actual level of risk. There is scientific uncertainty about cancer risk in the low-dose region below the range of epidemiologic observation, and the possibility of no risk cannot be excluded (CIRRPC 1992).

Health Effect Risk Estimators Used in This EIS

Health impacts from radiation exposure, whether from external or internal sources, generally are identified as "somatic" (i.e., affecting the exposed individual) or "genetic" (i.e., affecting descendants of the exposed individual). Radiation is more likely to produce somatic effects than genetic effects. The somatic risks of most importance are induced 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.

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[1] *Low dose is defined as the dose level where DNA repair can occur in a few hours after irradiation-induced damage. Currently, a dose level of about 0.2 grays (20 rad), or a dose rate of 0.1 milligrays (0.01 rad) per minute is considered low enough to allow the DNA to repair itself in a short period (EPA 1994).*

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. Such cancers, however, also produce relatively low mortality rates because they are relatively amenable to medical treatment. Because fatal cancer is the most probable serious effect of environmental and occupational radiation exposures, estimates of cancer fatalities rather than cancer incidence are presented in this EIS. The numbers of fatal cancers can be used to compare the risks among the various alternatives.

Based on the preceding discussion and the values presented in Table B–2, the number of fatal cancers to the general public during normal operations and for postulated accidents in which individual doses are less than 20 rem are calculated using a health risk estimator of 5×10^{-4} per person-rem. For workers, a risk estimator of 4×10^{-4} excess fatal cancers per person-rem is used. (The risk estimators are lifetime probabilities that an individual would develop a fatal cancer per rem of radiation received.) The lower value for workers reflects the absence of children (who are more radiosensitive than adults) in the workforce. The risk estimators associated with nonfatal cancer and genetic disorders among the public are 20 and 26 percent, respectively, of the fatal cancer risk estimator. For workers, these health risk estimators are both 20 percent of the fatal cancer risk estimator. The nonfatal cancer and genetic disorder risk estimators are not used in this EIS.

For individual doses of 20 rem or more, as could be associated with postulated accidents, the risk estimators used to calculate health effects to the general public and to workers are double those given in the previous paragraph, which are associated with doses of less than 20 rem.

The fatal cancer estimators are used to calculate the statistical expectation of the effects of exposing a population to radiation. For example, if 100,000 people were each exposed to one time radiation dose of 100 millirem (0.1 rem), the collective dose would be 10,000 person-rem. The exposed population would then be expected to experience 5 additional cancer fatalities from the radiation (10,000 person-rem $\times 5 \times 10^{-4}$ lifetime probability of cancer fatalities per person-rem = 5 cancer fatalities).

Calculations of the number of excess fatal cancers associated with radiation exposure do not always yield whole numbers. These calculations may yield numbers less than 1, especially in environmental impact applications. For example, if a population of 100,000 were exposed to a total dose of only 0.001 rem per person, the collective dose would be 100 person-rem, and the corresponding estimated number of cancer fatalities would be 0.05 (100,000 persons $\times$ 0.001 rem $\times 5 \times 10^{-4}$ cancer fatalities per person-rem = 0.05 cancer fatalities). The 0.05 means that there is one chance in 20 that the exposed population would experience one fatal cancer. In other words, the 0.05 cancer fatalities is the *expected* 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 fatal cancer from the 0.001 rem dose each member would have received. In a small fraction of the groups, 1 cancer fatality would result; in exceptionally few groups, 2 or more cancer fatalities would occur. The *average* expected number of deaths over all the groups would be 0.05 cancer fatalities (just as the average of 0, 0, 0, and 1 is 1/4, or 0.25). The most likely outcome is 0 cancer fatalities.

The same concept is applied to estimate the effects of radiation exposure on an individual member of the public. Consider the effects of an individual's exposure to a 360 millirem (0.36 rem) annual dose from all radiation sources. The probability that the individual will develop a fatal cancer from continuous exposure to this radiation over an average life of 72 years (presumed) is 0.013 (1 person $\times$ 0.36 rem per year $\times$ 72 years $\times 5 \times 10^{-4}$ cancer fatality risk per person rem = 0.013). This correlates to one chance in 77 that the individual would develop a fatal cancer.

B.3 METHODOLOGY FOR ESTIMATING RADIOLOGICAL IMPACTS

B.3.1 GENII Computer Code, a Generic Description

The radiological impacts from releases during normal operation of the facilities used to perform TA-18 missions were calculated using Version 1.485 of the GENII computer code (PNL 1988). Site-specific input data were used, including location, meteorology, population, and source terms. This section briefly describes GENII and outlines the approach used for normal operations.

B.3.1.1 Description of the Code

The GENII computer model, developed by Pacific Northwest National Laboratory, 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, method, and quality assurance issues. The GENII computer model has gone through extensive quality assurance and quality control steps, including comparing results from model computations with those from hand calculations and performing internal and external peer reviews (PNL 1988).

The GENII code consists of several modules for various applications; see the code manual (PNL 1988) for details. For this EIS, only the ENVIN, ENV, and DOSE computer modules were used. The output of one module is stored in a file that can be used by the next module in the system. The functions of the three GENII computer modules used in this EIS are discussed below.

ENVIN

The ENVIN module of the GENII code controls the reading of input files 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 based on 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 would generate tables of atmospheric dispersion parameters that are used in later calculations. If the finite plume air submersion option is selected in addition to the atmospheric dispersion calculations, preliminary energy-dependent finite plume dose factors can be prepared as well. 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 pre-existing sources, considering biotic transport of existing subsurface contamination, and defining soil contamination from continuing atmospheric or irrigation depositions. For each year of postulated exposure, the code then estimates the 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: (1) pathways of external exposure from finite atmospheric plumes; (2) inhalation; (3) external exposure from contaminated soil, sediments, and water; (4) external exposure from special geometries; and (5) 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.

DOSE

The DOSE module reads the intake and exposure rates defined by the ENV module and converts the data to radiation dose.

B.3.1.2 Data and General Assumptions

To perform the dose assessments for this EIS, different types of data were collected and generated. This section discusses the various data, along with the assumptions made for performing the dose assessments.

Dose assessments were performed for both members of the general public and workers at Los Alamos National Laboratory (LANL), Sandia National Laboratories/New Mexico (SNL/NM), Nevada Test Site (NTS), and Argonne National Laboratory-West (ANL-W). These assessments were made to determine the incremental doses that would be associated with the alternatives addressed in this EIS. Incremental doses for members of the public were calculated (via GENII) for two different types of receptors:

- Maximally Exposed Offsite Individual—The maximally exposed offsite individual was assumed to be an individual member of the public located at a position on the site boundary that would yield the highest impacts during normal operations.

- Population—The general population living within 80 kilometers (50 miles) of the facility.

Meteorological Data

The meteorological data used for all normal operational scenarios discussed in this EIS 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 taken over a period of several years at the LANL, SNL/NM, NTS, and ANL-W sites.

Population Data

Population distributions were based on U.S. Department of Commerce state population projections (DOC 1999). Projections were determined for the year 2001 for areas within 80 kilometers (50 miles) of the release locations at LANL, SNL/NM, NTS, and ANL-W. The projected site-specific population in 2001 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 kilometers (50 miles). The grid was centered at the location from which the radionuclides were assumed to be released.

Source Term Data

The site- and process-specific source terms used to calculate the impacts of normal operations are provided in Section B.4.

Food Production and Consumption Data

Generic food consumption rates are established in the U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.109 (NRC 1977). This regulatory guide provides guidance for evaluating ingestion doses from consuming contaminated terrestrial and animal food products using a standard set of assumptions for crop and livestock growth and harvesting characteristics.

Basic Assumptions

To estimate annual radiological impacts to the public from normal operations, the following additional assumptions and factors were considered in using GENII:

- Radiological airborne emissions were assumed to be released to the atmosphere at a height of 10 meters (33 feet).
- The exposure time to the plume was assumed to continue throughout a year for the maximally exposed offsite individual and the general population. Plume exposure parameters used in the GENII model are provided in **Table B–3**.
- The exposed individual or population was assumed to have the characteristics and habits of an adult human.
- A semi-infinite/finite plume model was used for the air immersion doses.

Table B–3 GENII Parameters for Exposure to Plumes (Normal Operations)

Maximally Exposed Offsite Individual			*General Population*		
External Exposure	*Inhalation of Plume*		*External Exposure*	*Inhalation of Plume*	
Plume (hours)	*Exposure Time (hours)*	*Breathing Rate (cubic centimeters per second)*	*Plume (hours)*	*Exposure Time (hours)*	*Breathing Rate (cubic centimeters per second)*
6,136	8,766	270	4,383	8,766	270

Sources: PNL 1988, NRC 1977.

Worker doses associated with TA-18 mission operations were determined from historical data. Refer to Section B.4 for a further discussion of worker impacts.

B.3.1.3 Uncertainties

The sequence of analyses performed to generate the radiological impact estimates from normal operations include: (1) selection of normal operational modes, (2) estimation of source terms, (3) estimation of environmental transport and uptake of radionuclides, (4) calculation of radiation doses to exposed individuals, and (5) estimation of health effects. There are uncertainties associated with each of these steps. Uncertainties exist in the way the physical systems being analyzed are represented by the computational models and in the data required to exercise the models (due to measurement, sampling, or natural variability).

In principle, one can estimate the uncertainty associated with each source and predict the remaining uncertainty in the results of each set of calculations. Thus, one can propagate the uncertainties from one set of calculations to the next and estimate the uncertainty in the final results. However, conducting such a full-scale quantitative uncertainty analysis is neither practical nor a standard practice for a study of this type. Instead, the analysis is designed to ensure—through judicious selection of release scenarios, models, and parameters—that the results represent the potential risks. This is accomplished by making conservative assumptions in the calculations at each step. The models, parameters, and release scenarios used in the calculations are selected in such a way that most intermediate results and, consequently, the final estimates of impacts are greater than would be expected. As a result, even though the range of uncertainty in a quantity might be large, the value calculated for the quantity would be close to one of the extremes in the range of possible values, so the chance of the actual quantity being greater than the calculated value would be low. The goal of the radiological assessment for normal operation in this study is to produce results that are conservative in order to capture any uncertainties in the operations of TA-18 mission facilities.

The degree of conservatism in the calculated results is related closely to the range of possible values the quantity can have. This range is determined by what realistically can be expected to occur. Limitations on the handling of material (e.g., design capacity/processing rate, system availability, operational duration) provide upper limits to the quantity of material that can be handled in a given time, e.g., annually. In many cases these restrictions were used to represent normal operating capacity, thus maximizing the amount of material that can be handled annually. Using these upper limits on processing rates provides a conservative estimate of the annual release of radionuclides during normal operation for each of the facilities. Conservative release estimates were used to calculate the annual impacts presented for each alternative. The uncertainties associated with the values of the health estimates used to project health effects, e.g. fatal cancer, are discussed in Section B.2.2.

B.4 RADIOLOGICAL RELEASES AND IMPACTS DURING NORMAL OPERATIONS

The estimated radiological releases to the environment associated with normal operation of the facilities used to perform TA-18 missions are discussed below. The methodology for estimating radiological impacts to the public, including associated input data and analytical assumptions, is provided in Section B.3.1. Information relevant to the determination of impacts to workers is given below. The resulting impacts to the public and to workers associated with each alternative or action are presented and discussed in Chapter 5 of this EIS.

Argon-40 gas is a nonradioactive nuclide that is a normal constituent of air, including the air surrounding the TA-18 mission facilities. Neutrons produced during normal operations of the facilities interact with this gas to produce argon-41, a radioactive argon isotope with a half-life of about 109 minutes. This argon-41 represents the only radioactive source term to which members of the public would be exposed during normal operations. It is estimated that about 100 curies per year of argon-41 would be associated with SHEBA operations and 10 curies per year with the operations of the other TA-18 mission facilities for a total of 110 curies per year of argon-41 released from all TA-18 operations (DOE 1999a). The amount of argon-41 to which the public would be exposed is specific to the alternative assessed. Two examples of this are: (1) under the No Action Alternative, 110 curies of argon-41 would be produced in the atmosphere from operating all TA-18 mission facilities, including SHEBA, and (2) under the Nevada Test Site Alternative, only 10 curies of argon-41 would be produced at NTS from operations of the TA-18 mission facilities because SHEBA would remain at LANL. The source term associated with each alternative is given in the "radiological release" subsections of Chapter 5. The impacts to the public are given and discussed in the "public and occupational health and safety" subsections of Chapter 5.

The average individual worker associated with TA-18 operations is calculated, based on historical operational data, to receive an annual dose of 100 millirem. It is estimated that 110 involved workers would be associated with SHEBA as other security Category III/IV operations and 100 involved workers would be associated with the TA-18 security Category I/II operations. As is the case with the radiological source term (above), the impacts to the workers are dependent on the specific alternative assessed. The impacts are presented and discussed in the "public and occupational health and safety" subsections of Chapter 5.

B.5 RADIOLOGICAL RELEASES AND IMPACTS ASSOCIATED WITH POSTULATED ACCIDENTS

The releases of radioactivity and associated impacts from postulated accidents are addressed in detail in Appendix C. The information is summarized in Chapter 5 of this EIS.

B.6 References

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APPENDIX C

Human Health Effects from Facility Accidents

TA-18

APPENDIX C
HUMAN HEALTH EFFECTS FROM FACILITY ACCIDENTS

C.1 INTRODUCTION

Accident analyses were performed to estimate the impacts on workers and the public from reasonably foreseeable accidents for the Los Alamos National Laboratory (LANL) Technical Area 18 (TA-18) mission relocation alternatives. The analyses were performed in accordance with National Environmental Policy Act (NEPA) guidelines, including the process followed for the selection of accidents, definition of accident scenarios, and estimation of potential impacts. The sections that follow describe the methodology and assumptions, accident selection process, selected accident scenarios, and consequences and risks of the accidents evaluated.

C.2 OVERVIEW OF METHODOLOGY AND BASIC ASSUMPTIONS

The radiological impacts from accidental releases from the facilities used to perform TA-18 missions were calculated using the MACCS computer code, Version 1.12 (MACCS2). A detailed description of the MACCS model is provided in NUREG/CR-4691 (NRC1990). The enhancements incorporated in MACCS2 are described in the *MACCS2 Users Guide* (SNL 1997). This section presents the MACCS2 data specific to the accident analyses. Additional information on the MACCS2 code is provided in Section C.8.

As implemented, the MACCS2 model evaluates doses due to inhalation of airborne material, as well as exposure to the passing plume. This represents the major portion of the dose that an individual would receive as a result of a TA-18 mission facility accident. The longer-term effects of radioactive material deposited on the ground after a postulated accident, including the resuspension and subsequent inhalation of radioactive material and the ingestion of contaminated crops, were not modeled for this environmental impact statement (EIS). These pathways have been studied and found to contribute less significantly to the dosage than the inhalation of radioactive material in the passing plume; they are also controllable through interdiction. Instead, the deposition velocity of the radioactive material was set to 0, so that material that might otherwise be deposited on surfaces remained airborne and available for inhalation. This adds a conservatism to inhalation doses that can become considerable at large distances. Thus, the method used in this EIS is conservative compared with dose results that would be obtained if deposition and resuspension were taken into account.

The impacts were assessed for the offsite population surrounding each site, the maximally exposed offsite individual, and a noninvolved worker. The impacts on involved workers were addressed qualitatively because no adequate method exists for calculating meaningful consequences at or near the location where the accident could occur. Involved workers are also fully trained in emergency procedures, including potential accidents.

The offsite population is defined as the general public residing within 80 kilometers (50 miles) of each site. The population distribution for each proposed site is based on U.S. Department of Commerce state population projections (DOC 1999). State and county population estimates were examined to interpolate the data to the year 2001. These data were fitted to a polar coordinate grid with 16 angular sectors aligned with the 16 compass directions, with radial intervals that extend outward to 80 kilometers (50 miles). The offsite population within 80 kilometers (50 miles) was estimated to be 320,182 persons at TA-18 (the No Action Alternative and the TA-18 Upgrade Alternative); 283,571 persons at TA-55 (the LANL New

Facility Alternative); 745,287 persons at TA-V[1] (the Sandia National Laboratories/New Mexico [SNL/NM] Alternative); 18,074 persons at the Device Assembly Facility (DAF) (the Nevada Test Site [NTS] Alternative); 239,099 persons at Argonne National Laboratory-West (ANL-W) (the ANL-W Alternative); and 450,302 persons at TA-39 (the Solution High-Energy Burst Assembly [SHEBA] proposed relocation site). For this analysis, no credit was taken for emergency response evacuations or temporary relocation of the general public.

The maximally exposed offsite individual is defined as a hypothetical individual member of the public who would receive the maximum dose from an accident. This individual is usually assumed to be located at a site boundary. However, for some sites, there are public residences within the site boundary, such as the trailer park within the LANL site boundary. In these instances, the maximally exposed individual could be at these onsite locations.

The maximally exposed offsite individual location was determined for each site. The maximally exposed individual location can vary at a site based on the type of accident. Therefore, some sites may have more than one location for the maximally exposed offsite individual. For this analysis, the maximally exposed offsite individual is located at 1.1 kilometers (0.7 miles) to the northeast (TA-18); 1 kilometer (0.6 miles) to the north and 2.6 kilometers (1.6 miles) to the east-southeast (TA-55); 2.0 kilometers (1.2 miles) to the northeast and to the north (TA-V); 10.9 kilometers (6.8 miles) to the east-northeast (DAF); 5.2 kilometers (3.2 miles) and 6.7 kilometers (4.2 miles) to the south-southeast (ANL-W); and 0.8 kilometers (0.5 miles) to the southwest (TA-39).

A noninvolved worker is defined as an onsite worker who is not directly involved in the facility activity pertaining to the accident. The noninvolved worker is assumed to be exposed to the full release, without any protection, at various distances from the point of release from facilities depending on the alternative or action being assessed. For SHEBA, this distance would be 400 meters (1,310 feet); for the other TA-18 mission facilities, this distance would be 400 meters (1,310 feet) if the facilities remain at TA-18, and 100 meters (330 feet) if the missions are relocated to TA-55, SNL/NM, NTS, or ANL-W. Workers would respond to a site emergency alarm and evacuate to a designated shelter area, reducing their exposure potential. For purposes of the analyses, however, it was conservatively assumed that no evacuation would take place.

Doses to the offsite population, the maximally exposed offsite individual, and a noninvolved worker were calculated based on site-specific meteorological conditions. Site-specific meteorology is described by one year of hourly windspeed atmospheric stability and by rainfall recorded at each site. The MACCS2 calculations produce distributions based on the meteorological conditions. For these analyses, the results presented are based on mean meteorological conditions. The mean produces more realistic consequences than a 95th percentile condition, which is sometimes used in accident analyses. The 95th percentile condition represents low-probability meteorological conditions that are not exceeded more than 5 percent of the time.

As discussed in Appendix B, the probability coefficients for determining the likelihood of a latent cancer fatality for low doses or dose rates are 0.0004 and 0.0005 fatal cancers per rem, applied to individual workers and individuals in the general public, respectively. For high doses received at a high rate, respective probability coefficients of 0.0008 and 0.001 fatal cancers per rem were applied for individual workers and individuals in the general public. The higher-probability coefficients apply where individual doses are above 20 rad or dose rates are above 10 rad per hour.

The preceding discussion focuses on radiological accidents. Chemical accident scenarios were not evaluated, since inventories of hazardous chemicals to support TA-18 operations do not exceed the Threshold Planning Quantities as stipulated on the Extremely Hazardous Substances List provided in Section 3.02 of the

[1]*Technical areas at Sandia National Laboratories/New Mexico are designated using roman numerals.*

Emergency Planning and Community Right-to-Know Act (EPA 1998). No specific analyses of the results of terrorist or sabotage acts were evaluated in this EIS. The U.S. Department of Energy (DOE) is considering impacts from sabotage in a separate analysis. Once completed, this analysis will be incorporated as a classified appendix in the final EIS. Industrial accidents were evaluated and the results are presented in Section C.7.

C.3 ACCIDENT SCENARIO SELECTION PROCESS

In accordance DOE NEPA guidelines, an EIS should, to the extent applicable, contain a representative set of accidents that includes various types such as fire, explosion, mechanical impact, criticality, spill, human error, natural phenomena, and external events. DOE's Office of NEPA Oversight, in the *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements*, the "Green Book" (DOE 1993), presents recommendations for determining which accident scenarios to analyze.

The accident scenario selection was based on evaluation of accidents reported in the *Basis for Interim Operations (TA-18 BIO)* (DOE 2001). The selection and evaluation of accidents in the *TA-18 BIO* was based on a process described in the *DOE Standard: Preparation Guide for U.S. Department of Energy New Reactor Nuclear Facility Safety Analysis Reports (New Reactor SAR Preparation Guide)* (DOE 1994a). The accident selection process for this EIS is described in Sections C.3.1 through C.3.3 for Steps 1 through 3, respectively.

C.3.1 Hazard Identification – Step 1

Hazard evaluation, or hazards analysis, is the process of identifying the material, system, process, and plant characteristics that can potentially endanger the health and safety of workers and the public and then analyzing the potential consequences to humans of accidents involving the identified hazards. The hazards analysis examines the complete spectrum of accidents that could expose members of the public, onsite workers, facility workers, and the environment to hazardous materials. The hazards present at TA-18 were identified by reviewing broad hazards lists, assessing the applicability to the facilities and activities at the site, and looking for possible unique hazards posed by the unique activities carried out at TA-18.

Hazards analysis teams were assembled by LANL to collect and review documentation pertinent to the activities, machines, and facilities at TA-18 (DOE 2001). They performed technical walk downs of each facility and observed, from the remote-control room, actual criticality experiments on the critical assembly machines. Technical discussions and interviews were held with TA-18 personnel covering the spectrum of activities carried out at the site. **Table C–1** indicates the range of activities investigated and assessed for inclusion in the hazards analysis.

Table C–1 TA-18 Activities Evaluated in the Hazards Analysis

Category	*Activity*
Detector development	Active interrogation
	Detector development and operation
Emergency response	Readiness activities
	Interagency training
	Criticality safety demonstration
	Low- and medium-dose radiography
Critical assembly machines	Storage of security Category I and II nuclear materials
	Manual handling of nuclear materials
	Licensed equipment operations (crane, hoist, forklift)
	Operation of special equipment (e.g., vacuum cleaner)

Category	***Activity***
Critical assembly machines (cont'd)	Detector development and operation
	Welding
	Radiation test object construction
	Use of CASA or miscellaneous buildings as temporary material access areas
	Temporary staging of vault materials into CASA workspace
	Transfer of FL-10 bottle contents
	Criticality safety demonstration
	Special nuclear materials handling demonstration
	Planned criticality
	Local mode of machine operation (Plan 2)
	Source handling
	Loading/unloading of core materials
	Machine setup and tear-down operations
	Uranium fuel solution handling (fueling, defueling, spill cleanup)
	Dosimeter retrieval
	Hand stacking, hand cranking of core materials
	Worker re-entry into CASA after operations
	Radiography (excludes linear accelerator)
	Radiography with linear accelerator
	Drum or counter assay
	Portal installation, development, and testing
	Package monitoring
	Transport of nuclear materials (truck, motorized cart, forklift)
	Uranium hexafluoride operations
	Propane bottle handling
Operation	Basic criticality safety class
	Advanced criticality safety class
	CASA maintenance
	Long-range alpha detector
Material protection, control, and accountability	Portal installation, development, and testing
	Package monitor development
	Accelerator operations
	Operation of portable linear accelerator
	Sealed neutron generators
Support activities	Work control
	Soldering
	Machinists
	General mechanical support
	Licensed equipment operations (cranes, hoist, forklifts, etc.)
	Welding, staff, and shop
	Gamma spectroscopy
	Source handling
	Health physics support
	Special nuclear materials moves
	Industrial hygiene support
	Handling gas cylinders
	Waste management

CASA = Critical Assembly Storage Area.
Source: DOE 2001.

Hazard tables were prepared for the TA-18 facilities and activities. A LANL team screened the hundreds of potential hazards in the hazard tables to develop a subset of approximately 400 major TA-18 radiological hazards for use in the preparation of the *TA-18 BIO* (DOE 2001).

C.3.2 Hazard Evaluation – Step 2

The LANL team preparing the *TA-18 BIO* subsequently screened the subset of approximately 400 major TA-18 radiological hazards developed in Step 1. Using a hazards analysis process based on guidance provided by the *New Reactor SAR Preparation Guide* (DOE 1994a), the 400 major hazards were reduced to 22 major accidents. The process ranks the risk of each hazard based on estimated frequency of occurrence and potential consequences to screen out low-risk hazards. The subset of 22 major accidents (i.e., 4 reactivity insertion accidents, 2 criticality accidents, 6 fire/explosion accidents, 6 natural-phenomena events, 1 external event, and 3 miscellaneous events) were identified for analysis in the *TA-18 BIO* (DOE 2001). Descriptions of critical assembly machines are provided in Appendix A.

C.3.3 Accidents Selected for This Evaluation – Step 3

The EIS team screened the subset of 22 major accidents analyzed in the *TA-18 BIO* (DOE 2001) to select a spectrum of accident scenarios for the No Action Alternative. The following accident categories were considered in the selection process:

- fire
- explosion
- uncontrolled reactivity insertion
- inadvertent criticality
- spill
- mechanical impact
- human error
- natural phenomena
- external events

Screening criteria used in the selection process included, but were not limited to: (1) consideration of the impacts on the public and workers of high-frequency/low-consequence accidents and low-frequency/high-consequence accidents; (2) selection of the highest-impact accident in each accident category to envelope the impacts of all potential accidents; and (3) consideration of only reasonably foreseeable accidents. The list of No Action Alternative accident scenarios was reviewed for applicability to the other reasonable alternatives evaluated in this EIS. In addition, hazards and accident analyses at the candidate sites were reviewed to determine the potential for accidents initiated by external events (e.g., aircraft crash, and explosions in collocated facilities) and natural phenomena (e.g., external flooding, earthquake, extreme winds, and missiles).

Accident scenarios that involved the spill of radioactive material or the release of radioactive material due to mechanical impacts of machines or storage containers were considered but not evaluated in this EIS. The explosion scenario envelopes the worker and public health and safety impacts of these potential scenarios, where machine and storage containers in the facility were breached by the force of the explosion. Accident scenarios initiated by human error are evaluated in this EIS. Human error can be the initiating event for the postulated inadvertent criticality and uncontrolled reactivity insertion accident scenarios.

The results of the Step-3 selection process are presented below for each of the accident categories.

Fire – The high-pressure spray fire on a Comet machine, with a plutonium core, was selected from the list of fire accidents evaluated in the *TA-18 BIO* because it has a potentially large impact. Unmitigated, the fire has the potential to damage the Comet machine plutonium core. This accident scenario is applicable to all alternatives, excluding activities involving SHEBA relocation.

Explosion – Hydrogen detonation in SHEBA was selected as the representative explosion accident scenario. This accident scenario was selected because the accident analyses postulated that the force of the explosion could damage not only the SHEBA core, but also storage containers in the facility and could release additional radioactive material. This scenario is applicable to the two alternatives that involve SHEBA, the No Action and TA-18 Upgrade Alternatives, and to SHEBA relocation.

Uncontrolled reactivity insertion – Since TA-18 operations involve tests with both solid and liquid cores, two uncontrolled reactivity insertion accident scenarios were selected for evaluation in this EIS. The uncontrolled reactivity insertion in Comet or Planet, with a plutonium core, was selected as a representative scenario for insertions into a solid core. This scenario is applicable to all alternatives, excluding activities involving SHEBA relocation.

The uncontrolled reactivity insertion in SHEBA, in the burst mode, was selected as a representative scenario for insertions into a liquid core. This scenario is applicable to the two alternatives that involve SHEBA (i.e., the No Action and TA-18 Upgrade Alternatives).

Inadvertent criticality – Since TA-18 operations involve the handling of both solid and liquid radioactive materials, two inadvertent criticality accident scenarios were selected for evaluation in this EIS. The first postulated scenario is a bare, fully reflected, or moderated metal criticality accident. This scenario is applicable to all alternatives but is not applicable to SHEBA relocation. The second scenario postulates an inadvertent solution criticality. Since the handling of radioactive solutions is primarily associated with SHEBA operations, the inadvertent solution criticality scenario is applicable to the two alternatives that involve SHEBA, the No Action and TA-18 Upgrade Alternatives, and to SHEBA relocation.

Natural phenomena (earthquake) – The earthquake-induced facility collapse, without fire, was selected as the representative natural phenomena-induced accident scenario. At TA-18, natural gas from broken pipelines that would otherwise cause a fire is released through the rubble and fails to reach a flammable mixture. This scenario is applicable to all alternatives and to SHEBA relocation. The failure (i.e., collapse) of existing facilities and proposed new facilities due to an earthquake is based on site-specific facility seismic design features and the return frequencies for earthquakes with forces that significantly exceed the design-basis earthquake for the facility. An earthquake with less force, causing less damage, could trap natural gas from broken pipelines, leading to a fire, but with a smaller source term and lower impacts.

External events (aircraft crash) – The locations of existing facilities and the proposed locations of new facilities were evaluated to determine the probability of an aircraft impacting the facility, penetrating the facility, and damaging equipment and/or storage containers, causing the release of radioactive material. In those cases where the probability was less than 1.0×10^{-7} per year (i.e., less than 1 chance in 10 million years), the postulated scenario is not considered credible and is not evaluated in the EIS. The only alternative considered vulnerable to the high-energy aircraft-crash accident scenario is the SNL/NM Alternative. The accident scenario is initiated by a large aircraft crashing into an underground facility. The frequency of this accident is estimated to be 6.3×10^{-6} per year. However, analysis showed that there would be no damage to the materials at risk and, therefore, no radiological release to the environment (SNL/NM 2001). Therefore, this accident was eliminated from further analysis.

The locations of the existing facilities and the proposed locations of new facilities were also evaluated to determine if an accident in an adjacent facility or in a collocated or shared facility supporting another mission could propagate or initiate an accident in a facility with a TA-18-related mission. No externally initiated reasonably foreseeable accidents were identified that could affect the relocated TA-18 mission facilities.

Table C–2 shows the correlation between accidents and alternatives.

Table C–2 Applicability of TA-18 Existing Facilities Accidents to Alternatives

Accident Scenario	*Alternatives*						*Relocation of Security Category III/IV and SHEBA*
	No Action	*TA-18 Upgrade*	*LANL New Facility*	*SNL/NM*	*NTS*	*ANL-W*	
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	Yes	Yes	Yes	Yes	Yes	Yes	No
Bare, fully reflected, or moderated metal criticality	Yes	Yes	Yes	Yes	Yes	Yes	No
High-pressure spray fire on a Comet machine with a plutonium core	Yes	Yes	Yes	Yes	Yes	Yes	No
Earthquake-induced facility failures without fire	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Uncontrolled reactivity insertion in SHEBA in burst mode	Yes	Yes	No	No	No	No	Yes
Hydrogen detonation in SHEBA	Yes	Yes	No	No	No	No	Yes
Inadvertent solution criticality	Yes	Yes	No	No	No	No	Yes

C.4 Accident Scenario Descriptions and Source Term

This section describes the accident scenarios and corresponding source term developed for the relocation of TA-18 operations. The spectrum of accidents described below was used to determine the consequences (public and worker doses) and associated risks. Additional assumptions were made when further information was required to clarify the accident condition, update some of the parameters, or facilitate the evaluation process; these are referenced in each accident description.

The source term is the amount of respirable radioactive material released to the air, in terms of curies or grams, assuming the occurrence of a postulated accident. The airborne source term is typically estimated by the following equation:

$$\text{Source term} = \text{material at risk} \times \text{damage ratio} \times \text{airborne release fraction} \times \text{respirable fraction} \times \text{leak path factor}$$

The material at risk is the amount of radionuclides (in curies of activity or grams for each radionuclide) available for release when acted upon by a given physical stress (i.e., an accident). The material at risk is specific to a given process in the facility of interest. It is not necessarily the total quantity of material present, but is that amount of material in the scenario of interest postulated to be available for release.

The damage ratio is the fraction of material exposed to the effects of the energy, force, or stress generated by the postulated event. For the accident scenarios discussed in this analysis, the value of the damage ratio varies from 0.1 to 1.0.

The airborne release fraction is the fraction of material that becomes airborne due to the accident. In this analysis, airborne release fractions were obtained from the *TA-18 BIO* (DOE 2001) or the *DOE Handbook* on airborne release fractions (DOE 1994b).

The respirable fraction is the fraction of the material with a 10-micrometer (micron) or less aerodynamic-equivalent diameter particle size that could be retained in the respiratory system following inhalation. The respirable fraction values are also taken from the *TA-18 BIO* (DOE 2001) or the *DOE Handbook* on airborne release fractions (DOE 1994b).

The leak path factor accounts for the action of removal mechanisms (e.g., containment systems, filtration, deposition) to reduce the amount of airborne radioactivity ultimately released to occupied spaces in the facility or the environment. A leak path factor of 1.0 (i.e., no reduction) is assigned in accident scenarios involving a major failure of confinement barriers. Leak path factors were obtained from the *TA-18 BIO* (DOE 2001) and site-specific evaluations.

Since the isotopic composition and shape of some of the nuclear materials are classified, the material inventory has been converted to equivalent amounts of plutonium-239. The conversion was on a constant-consequence basis, so that the consequences calculated in the accident analyses are equivalent to what they would be if actual material inventories were used. The following sections describe the selected accident scenarios and corresponding source terms for each alternative.

C.4.1 Uncontrolled Reactivity Insertion in Comet or Planet with a Plutonium Core

An uncontrolled reactivity insertion in Comet or Planet could occur if additional fissile material is inadvertently added to the plutonium core; the geometry of the core is changed so that it has a higher reactivity; neutron-absorbing material in the system is removed; or a substance is placed outside the core which improves the reflection of neutrons from the core back into the core. This reactivity can be added as an immediate step increase or as a gradually increasing reactivity.

The scenario assumes a step insertion of reactivity followed by a runaway power excursion accident in Comet or Planet with a plutonium core. The accident is initiated by an unplanned reactivity insertion in either a Comet or Planet machine caused by a large deviation from the experiment plan and other human errors. Core damage is possible depending on the amount of excess reactivity insertion. The extent of any core damage also depends on the insertion rate (fast or slow) and the operator's response in initiating reactor protection-system scram. Core damage can range from fuel surface oxidation to fuel melting. Fuel melting has a higher airborne release fraction than metal oxidation. For this analysis, an unmitigated case is evaluated (i.e., no credit is taken for reactor protection-system scram or opportunities for operator-initiated manual scram). For this accident scenario, a bounding reactivity[2] insertion of $0.80 is postulated. This level of reactivity insertion is in excess of the administrative control limit of $0.50 and, therefore, is extremely conservative. Appendix A, Section A.1, provides a detailed discussion of reactivity.

The estimated frequency of this event is 1.0×10^{-6} per year. The material at risk is approximately 27 kilograms (60 pounds) of plutonium-239 equivalent metal. The damage ratio is 1.0 (i.e., the accident causes the entire core to melt). The airborne release fraction is 0.01, and the respirable fraction is 1.0.

[2] *Reactivity is the fractional change in neutron multiplication factor from one neutron generation to the next. Reactivity in dollars is equal to the delayed neutron fraction corresponding to a multiplication factor of 1.002 for a plutonium-239 core.*

For the No Action Alternative, the leak path factor is assumed to be 1.0 because the buildings are not specifically designed to contain or filter releases. This results in a source term of approximately 270 grams (10 ounces) of plutonium-239 equivalent.

For the TA-18 Upgrade, LANL New Facility, SNL/NM, NTS, and ANL-W Alternatives, the leak path factor is assumed to be 0.001 due to the implementation of improved containment, including high-efficiency particulate air filtration systems. This results in a source term of approximately 0.27 grams (0.01 ounces) of plutonium-239 equivalent.

In addition to the plutonium release, there would also be a fission product release. The fission products, however, were not included in the source term because analysis showed that the fission product release consequence contribution would be a minute fraction of the plutonium release and would not change the presented results (DOE 2001).

C.4.2 Bare, Fully Reflected, or Moderated Metal Criticality

An inadvertent criticality of a solid metal fissile material assembly could occur if the number of neutrons leaking out of the system (and therefore not available for further fissions) is reduced by introducing or enhancing reflection of these neutrons back into the fissile material. The number of neutrons available to cause additional fissions directly affects a system's ability to become critical. Some neutrons leak out of a mass of fissile material and are not available for further fissions, but a reflector outside the fissile material returns many of these leaking neutrons back to the fissile atoms.

The accident is a solid criticality involving fissile material, reflectors, and moderators resulting from mechanical failures or human errors that lead to introduction or increase of reflection in the system. The accident may be caused by computational errors in criticality safety evaluations, mechanical failures, or human errors that lead to the introduction of moderators in the system, or by human errors in following procedures or established criticality safety limits. A single-pulse yield of 1.0×10^{17} fissions is assessed to be bounding for metal criticalities.

The estimated frequency of this event is 1.0×10^{-6} to 1.0×10^{-4} per year. For this analysis, the high end of the frequency range, 1.0×10^{-4} per year, was conservatively chosen. The damage ratio is 0.1. The respirable fraction is 1.0. The airborne release fractions are 0.5 (krypton, xenon); 0.2 (cesium, rubidium); 0.03 (barium, strontium); 0.05 (iodine); 0.07 (tellurium); 0.002 (ruthenium, rhodium); 0.03 (molybdenum, niobium, technetium); 0.0004 (cerium, zirconium); 0.0006 (lanthanum, praseodymium, neodymium, yttrium); and 0.004 (antimony). The damage ratio and the airborne release fractions were obtained from the *DOE Handbook* on airborne release fractions (DOE 1994b).

For the No Action Alternative, the leak path factor is assumed to be 1.0 because the buildings are not specifically designed to contain or filter releases. The radioisotopes were obtained from the *TA-18 BIO* (DOE 2001). The source term for the No Action alternative is presented in **Table C–3**.

For the TA-18 Upgrade, LANL New Facility, SNL/NM, NTS, and ANL-W Alternatives, the leak path factors are assumed to be 1.0 (noble gases), 0.01 (halogens), and 0.001 (particulates) due to the implementation of improved containment, including high-efficiency particulate air and charcoal filtration systems. The source terms for these alternatives are also presented in Table C–3.

Table C–3 Solid Criticality Source Terms

Isotope	*1 × 10^17 Fissions Activity (curies)*	*No Action Alternative Release Activity (curies)*	*All Other Alternatives Release Activity (curies)*
Krypton-85	3.68×10^{-7}	1.48×10^{-8}	1.48×10^{-8}
Krypton-85m	0.0118	0.00059	0.00059
Krypton-87	0.566	0.0283	0.0283
Krypton-88	1.25	0.0625	0.0625
Rubidium-86	1.26×10^{-6}	2.52×10^{-8}	2.52×10^{-11}
Strontium-89	0.0000364	1.09×10^{-7}	1.09×10^{-10}
Strontium-90	1.54×10^{-6}	4.62×10^{-9}	4.62×10^{-12}
Strontium-91	0.199	0.000597	5.97×10^{-7}
Strontium-92	2.14	0.00642	6.42×10^{-6}
Yttrium-90	8.89×10^{-6}	5.33×10^{-10}	5.33×10^{-13}
Yttrium-91	0.0000198	1.19×10^{-9}	1.19×10^{-12}
Yttrium-92	0.0448	2.69×10^{-6}	2.69×10^{-9}
Yttrium-93	0.0952	5.71×10^{-6}	5.71×10^{-9}
Zirconium-95	0.000472	1.89×10^{-8}	1.89×10^{-11}
Zirconium-97	0.539	0.0000216	2.16×10^{-8}
Niobium-95	4.45×10^{-6}	1.34×10^{-8}	1.34×10^{-11}
Molybdenum-99	0.00150	4.50×10^{-6}	4.50×10^{-9}
Technetium-99m	5.24×10^{-6}	1.57×10^{-8}	1.57×10^{-11}
Ruthenium-103	5.26×10^{-6}	1.05×10^{-9}	1.05×10^{-12}
Ruthenium-105	0.0902	0.000018	1.80×10^{-8}
Ruthenium-106	0.00046	9.20×10^{-8}	9.20×10^{-11}
Rhodium-105	9.07×10^{-6}	1.81×10^{-9}	1.81×10^{-12}
Antimony-127	0.00242	9.68×10^{-7}	9.68×10^{-10}
Antimony-129	0.648	0.000259	2.59×10^{-7}
Tellurium-127	0.000216	1.51×10^{-6}	1.51×10^{-9}
Tellurium-127m	7.73×10^{-7}	5.41×10^{-9}	5.41×10^{-12}
Tellurium-129	0.132	0.000924	9.24×10^{-7}
Tellurium-129m	0.00019	1.33×10^{-6}	1.33×10^{-9}
Tellurium-131	5.53	0.0387	0.0000387
Tellurium-131m	0.0768	0.000538	5.38×10^{-7}
Tellurium-132	0.180	0.00126	1.26×10^{-6}
Iodine-131	0.000313	1.57×10^{-6}	1.57×10^{-8}
Iodine-132	0.309	0.00155	0.0000155
Iodine-133	0.233	0.00117	0.0000117
Iodine-134	13.0	0.065	0.00065
Iodine-135	3.43	0.0172	0.000172
Xenon-133	0.000385	0.0000193	0.0000193
Xenon-135	0.264	0.0132	0.0132
Cesium-136	0.00168	0.0000336	3.36×10^{-8}
Cesium-137	0.000015	3.00×10^{-7}	3.00×10^{-10}
Barium-139	1.36	0.00408	4.08×10^{-6}
Barium-140	0.0135	0.0000405	4.05×10^{-8}
Lanthanum-140	0.00307	1.84×10^{-7}	1.84×10^{-10}
Lanthanum-141	0.0502	3.01×10^{-6}	3.01×10^{-9}
Lanthanum-142	0.593	0.0000356	3.56×10^{-8}
Cerium-141	5.68×10^{-7}	2.27×10^{-11}	2.27×10^{-14}

Isotope	1×10^{17} Fissions Activity (curies)	No Action Alternative Release Activity (curies)	All Other Alternatives Release Activity (curies)
Cerium-143	0.002	8.00×10^{-8}	8.00×10^{-11}
Cerium-144	0.0000609	2.44×10^{-9}	2.44×10^{-12}
Praseodymium-143	1.45×10^{-7}	8.70×10^{-12}	8.70×10^{-15}
Neodymium-147	0.0000123	7.38×10^{-10}	7.38×10^{-13}

Sources: DOE 1994b, DOE 2001.

C.4.3 High-Pressure Spray Fire on the Comet Machine with a Plutonium Core

An operational accident could occur involving a fire on one of the experimental machines in the three TA-18 Critical Assembly Storage Areas (CASAs) while fueled with a plutonium core. For this analysis, the accident is assumed to occur on the Comet machine because it has the most material at risk. A high-pressure spray fire resulting from a leak on the motor side of the hydraulic system fuels the postulated fire. The hydraulic system is an integral part of the Comet machine. A puncture in the high-pressure portion of the system is presumed to produce a spray-like fire that directly impinges on the underside of the aluminum plate on which the special nuclear material is placed. The flame melts the aluminum plate and then the plutonium core.

The estimated frequency of this event is 1.0×10^{-6} per year. The material at risk is approximately 27 kilograms (60 pounds) of plutonium-239 equivalent metal. The damage ratio is 1.0. The airborne release fraction is 0.01 and the respirable fraction is 1.0.

For the No Action Alternative, the leak path factor is assumed to be 1.0 because the buildings are not specifically designed to contain or filter releases. This results in a source term of approximately 270 grams (10 ounces) of plutonium-239 equivalent. The fire adds heat to the release, creating buoyancy, which results in a different release pattern and, therefore, different consequences than the 270 grams (10 ounces) released in the uncontrolled reactivity insertion accident.

For the TA-18 Upgrade, LANL New Facility, SNL/NM, NTS, and ANL-W Alternatives, the leak path factor is assumed to be 0.1 due to the implementation of improved containment, including high-efficiency particulate air filtration systems. This results in a source term of approximately 27 grams (1 ounce) of plutonium-239 equivalent.

C.4.4 Earthquake-Induced Facility Failures without Fire

The accident scenario is initiated by an earthquake event. The event produces sufficient peak ground acceleration to initiate the common-cause collapse of all facilities and the release of respirable material without fire. The *TA-18 BIO* (DOE 2001) described other earthquake events, including an event with a fire. For a fire to occur, the earthquake event must be of sufficient magnitude to damage a natural gas line, while leaving structures substantially intact to retain the released gas. The concentration of the natural gas would build up in the structure and could potentially ignite. The earthquake event with a fire, as well as the other earthquake events, however, all lead to lesser releases than the bounding event in this analysis. Sufficient damage occurs in the bounding event that the leaking natural gas would be dispersed to the atmosphere through the rubble and, therefore, fail to accumulate to a flammable concentration.

The frequency of an earthquake event of this magnitude is estimated to be 0.0001 per year. The material at risk is approximately 360 kilograms (794 pounds) of plutonium-239 equivalent in various forms. The damage ratio is 1.0 for all material forms and facilities. The airborne release fractions for all facilities are 0.0 (metal); 0.00006 (ceramic); 0.002 (powder); 0.0002 (liquid); and 1.0 (gas). The respirable fraction for all facilities is 1.0 (metal, ceramic, gas); 0.3 (powder); and 0.8 (liquid).

For the No Action Alternative, the leak path factor is assumed to be 1.0 because the buildings are assumed to have failed with no potential to contain or filter releases. This results in a source term of approximately 17 grams (0.6 ounces) of plutonium-239 equivalent.

For the TA-18 Upgrade Alternative, the leak path factor is assumed to be 1.0 because the buildings are assumed to have failed with no potential to contain or filter releases. This results in a source term of approximately 17 grams (0.6 ounces) of plutonium-239 equivalent.

For the LANL New Facility, SNL/NM, NTS, and ANL-W Alternatives, the leak path factor is assumed to be 0.001 because the facilities would be located underground, creating an arduous leak path, especially for particulates. The material at risk is approximately 350 kilograms (770 pounds) of plutonium-239 equivalent due to the absence of SHEBA. This results in a source term of approximately 0.015 grams (0.0005 ounces) of plutonium-239 equivalent.

For SHEBA relocation to TA-39, the material at risk is approximately 10 kilograms (22 pounds) of plutonium-239 equivalent. Assuming the material at risk is in liquid form, the airborne release factor is 0.0002 and the respirable fraction is 0.8. The leak path factor for this accident is assumed to be 1.0. This results in a source term of 1.6 grams (0.056 ounces) of plutonium-239 equivalent.

C.4.5 Uncontrolled Reactivity Insertion in SHEBA in Burst Mode

Burst operations in SHEBA are conducted by gradually filling the critical assembly vessel (CAV) with fuel until a stable, delayed critical condition is achieved. The safety rod is then inserted to terminate neutron multiplication and additional fuel is added to the CAV, followed by rapid withdrawal of the safety rod to initiate the burst. An unanticipated or larger-than-planned prompt critical burst is postulated as a result of failed engineering and administrative controls. The unmitigated reactivity insertion accident is assumed to result in the overpressure rupture of the CAV. Vessel fragments are assumed to also impact material located in the SHEBA building.

The estimated frequency of this event is 1.0×10^{-6} per year. The material at risk is approximately 10 kilograms (22 pounds) of plutonium-239 equivalent metal in mostly metal form and very small amounts in ceramic and liquid forms. The damage ratio is 1.0 for all material forms. The airborne release fractions for the SHEBA core are 1.0 (metal, gas); 0.006 (ceramic, powder); and 0.00005 (liquid). The SHEBA building airborne release fractions are 0.0005 (metal); 0.005 (ceramic, powder); 0.00005 (liquid); and 1.0 (gas). The respirable fractions for the SHEBA core are 1.0 (metal, gas); 0.02 (ceramic, powder); and 0.8 (liquid). The SHEBA building respirable release fractions are 0.5 (metal); 0.4 (ceramic, powder); 0.8 (liquid); and 1.0 (gas). The leak path factor for this accident, regardless of location, is assumed to be 1.0 because the buildings are not designed to contain releases. This results in a source term of approximately 700 grams (25 ounces) of plutonium-239 equivalent.

C.4.6 Hydrogen Detonation in SHEBA

Hydrogen detonation could occur under certain conditions and involve nuclear materials placed in the SHEBA core and/or the SHEBA building. Normal high levels of ionizing radiation generated during SHEBA experiments can cause radiolytic decomposition of water and production of hydrogen. Under sufficiently high energy levels, hydrogen is released to the cover gas space. The unmitigated accident scenario assumes the cover gas system is not operating, resulting in hydrogen detonation or, under partial mitigation in which there is a partial failure of the cover gas system, hydrogen deflagration. For this analysis, the bounding hydrogen detonation scenario is evaluated.

The estimated frequency of this event is 0.0054 per year. The material at risk is approximately 0.9 kilograms (2 pounds) (ceramic); 0.009 kilograms (0.3 ounces) (liquid); 0.7 kilograms (1.5 pounds) (metal); and 0.00006 kilograms (0.002 ounces) (powder) of plutonium-239 equivalent. The damage ratio is 1.0 for all material forms. The airborne release fractions are 0.0005 (metal); 0.005 (ceramic, powder); and 0.00005 (liquid). The respirable release fractions are 0.5 (metal); 0.4 (ceramic, powder); and 0.8 (liquid). The leak path factor is assumed to be 1.0 because the buildings are not designed to contain releases. This results in a source term of approximately 2 grams (0.07 ounces) of plutonium-239 equivalent.

C.4.7 Inadvertent Solution Criticality in SHEBA

An inadvertent solution criticality could occur in a solution containing one or more fissile isotopes if one or more of the following occurs: (1) the fissile isotope concentration is increased; (2) the total solution mass increases; (3) the geometric configuration of the solution changes in a way that increases its reactivity; or (4) materials are placed outside the solution vessel that reflect neutrons back into the solution, thereby increasing its reactivity. It could occur in a vault or CASA used to support SHEBA operations. It would involve an enriched fuel solution such as uranyl fluoride or nitrate up to 93 percent enriched fuel. In the vault, the most likely initiating events are the reconfiguration of five or six FL-10 containers by maintenance personnel or a seismic event. In a CASA, the criticality could be initiated by mishandling, leading to a spill or reconfiguration such as excessive stacking/reflection. An inadvertent solution criticality could also occur in Building 168 in SHEBA caused by human errors such as miscalculation or inadequate transfers during a switchover to a new fissile solution. No other operations or activities within TA-18 are assumed to handle, stage, or store fissile solutions in sufficient quantities to pose a solution criticality concern. A total yield of 3×10^{18} fissions is assessed to be bounding for all expected postulated solution criticalities at TA-18.

The estimated frequency of this event is 1.0×10^{-6} per year. The material at risk is approximately 100 liters (26.4 gallons), with an assumed fuel composition of 0.855 percent uranium-234; 93.04 percent uranium-235; 0.269 percent uranium-236; and 5.836 percent uranium-238. The damage ratio is 1.0. The analysis assumes that 25 percent of the solution boils off and 75 percent remains in a bulk configuration. The airborne release fraction and respirable fraction are different for the boiled/ejected and nonejected fractions of the solution. The airborne respirable fractions are 1.0 (krypton, xenon); 0.001 (cesium, rubidium, rhodium, ruthenium, tellurium); 0.000625 (antimony, barium, cerium, lanthanum, molybdenum, neodymium, niobium, praseodymium, strontium, technetium, yttrium, zirconium); and 0.4375 (iodine). The unmitigated leak path factor is conservatively assumed to be 1.0 with no depletion or plate out during transport within the building. The resulting source term is presented in **Table C–4**.

Table C–4 Liquid Criticality Source Terms

Isotope	*3×10^{18} Fissions Activity (curies)*	*Release Activity (curies)*
Krypton-85	3.94×10^{-6}	3.94×10^{-6}
Krypton-85m	0.559	0.559
Krypton-87	44.8	44.8
Krypton-88	63.0	63.0
Rubidium-86	0.0000126	1.26×10^{-8}
Strontium-89	0.000327	7.88×10^{-9}
Strontium-90	0.0000194	2.04×10^{-7}
Strontium-91	2.91	1.21×10^{-8}
Strontium-92	81.3	0.00182
Yttrium-90	0.000551	0.0508
Yttrium-91	0.0000315	3.44×10^{-7}
Yttrium-92	0.352	1.97×10^{-8}
Yttrium-93	1.67	0.00022

Isotope	***3×10^{18} Fissions Activity (curies)***	***Release Activity (curies)***
Zirconium-95	0.00313	0.00104
Zirconium-97	18.6	1.96×10^{-6}
Niobium-95	3.41×10^{-6}	0.0116
Molybdenum-99	0.0374	2.13×10^{-9}
Technetium-99m	9.38×10^{-6}	0.0000234
Ruthenium-103	0.0000313	3.13×10^{-8}
Ruthenium-105	0.0969	0.0000969
Ruthenium-106	0.0000294	2.94×10^{-8}
Rhodium-105	4.93×10^{-6}	4.93×10^{-9}
Antimony-127	0.00891	5.57×10^{-6}
Antimony-129	3.03	0.00189
Tellurium-127	0.000345	3.45×10^{-7}
Tellurium-127m	7.73×10^{-6}	7.73×10^{-9}
Tellurium-129	1.67	0.00167
Tellurium-129m	0.00221	2.21×10^{-6}
Tellurium-131	42.1	0.0421
Tellurium-131m	1.01	0.00101
Tellurium-132	3.14	0.00314
Iodine-131	0.0033	0.00133
Iodine-132	1.17	0.512
Iodine-133	1.31	0.573
Iodine-134	78.0	34.1
Iodine-135	75.1	32.9
Xenon-133	0.000822	0.000822
Xenon-135	1.63	1.63
Cesium-136	0.00268	2.68×10^{-6}
Cesium-137	0.0000679	6.79×10^{-8}
Barium-139	7.93	0.00496
Barium-140	0.224	0.00014
Lanthanum-140	0.0224	0.000014
Lanthanum-141	0.819	0.000512
Lanthanum-142	10.6	0.00663
Cerium-141	4.80×10^{-6}	3.0×10^{-9}
Cerium-143	0.155	0.0000969
Cerium-144	0.00171	1.07×10^{-6}
Praseodymium-143	1.38×10^{-6}	8.63×10^{-10}
Neodymium-147	0.0002	1.25×10^{-7}

Source: DOE 2001.

C.5 ACCIDENT ANALYSES CONSEQUENCES AND RISK RESULTS

Once the source term for each accident scenario is determined, the radiological consequences are calculated. The calculations vary depending on how the release is dispersed, what material is involved, and which receptor is being considered. Risks are calculated based on the accident's frequency and its consequences. The risks are stated in terms of additional cancer fatalities resulting from a release.

For example, if the dose to the maximally exposed individual is 10 rem, the probability of a latent cancer fatality is $10 \times 0.0005 = 0.005$, where 0.0005 is the latent cancer fatality probability factor. If the maximally exposed individual receives a dose in excess of 20 rem, the latent cancer probability factor is doubled to 0.001. Thus, if the maximally exposed individual receives a dose of 30 rem, the latent cancer probability factor is 30 × 0.001 = 0.03.

For a noninvolved worker, the latent cancer fatality probability factor is 0.0004 rather than the 0.0005 factor used for the public. If a noninvolved worker receives a dose of 10 rem, the probability of a latent cancer fatality is 10 × 0.0004 = 0.004. As with the maximally exposed individual, if the dose exceeds 20 rem, the latent cancer probability factor doubles to 0.008.

For the population, the same latent cancer fatality probability factors are used to determine the estimated number of latent cancer fatalities. The MACCS2 computer code calculates the dose to each individual in the exposed population and then applies the appropriate latent cancer probability factor (i.e., 0.0005 for doses less than 20 rem or 0.001 for doses greater than or equal to 20 rem). Therefore, for some releases, the estimated number of latent cancer fatalities will not be a straight multiplication from the population dose. For example, at TA-18, the uncontrolled reactivity insertion in SHEBA in a burst-mode accident results in a population dose of 6,580 person-rem with 3.93 estimated latent cancer fatalities. The estimated number of latent cancer fatalities is between the 0.0005 and 0.001 probability factors. The 0.0005 factor would yield 3.29 cancer fatalities and the 0.001 would yield 6.58 cancer fatalities. This indicates that some members of the population received doses in excess of 20 rem. Allowing the computer code to calculate the number of latent cancer fatalities results in a more realistic number of potential latent cancer fatalities than using a straight multiplication factor.

The following tables (**C–5** through **C–18**) provide the results, which are presented in two tables for each alternative. The first of these tables presents the consequences (doses and latent cancer probability), assuming the accident occurs. The second provides the annual cancer risks, taking into account the accident frequency.

Table C–5 Accident Frequency and Consequences under the No Action Alternative

Accident	Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population [a]		Noninvolved Worker	
		Dose (rem)	Latent Cancer Fatalities [b]	Dose (person-rem)	Latent Cancer Fatalities [c]	Dose (rem)	Latent Cancer Fatalities [b]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	1.0×10^{-6}	8.70	0.00435	2,580	1.30	133	0.106
Bare, fully reflected or moderated metal criticality	0.0001	2.49×10^{-7}	1.25×10^{-10}	0.0000669	3.34×10^{-8}	2.58×10^{-6}	1.03×10^{-9}
Uncontrolled reactivity insertion in SHEBA in burst mode	1.0×10^{-6}	22.2	0.0222	6,580	3.93	339	0.271
High-pressure spray fire on a Comet machine with a plutonium core	1.0×10^{-6}	2.09	0.00105	2,180	1.09	6.28	0.00251
Hydrogen detonation in SHEBA	0.0054	0.0625	0.0000313	18.8	0.00942	0.909	0.000364
Earthquake-induced facility failures without fire	0.0001	0.413	0.000207	158	0.0792	5.96	0.00238
Inadvertent solution criticality in SHEBA	1.0×10^{-6}	0.000185	9.25×10^{-8}	0.058	0.0000288	0.00179	7.16×10^{-7}

[a] Based on a population of 320,182 persons residing within 80 kilometers (50 miles) of the site.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

Table C–6 Annual Cancer Risks Due to Accidents under the No Action Alternative

Accident	Maximally Exposed Offsite Individual [a]	Offsite Population [b, c]	Noninvolved Worker [a]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	4.35×10^{-9}	1.30×10^{-6}	1.06×10^{-7}
Bare, fully reflected or moderated metal criticality	1.25×10^{-14}	3.34×10^{-12}	1.03×10^{-13}
Uncontrolled reactivity insertion in SHEBA in burst mode	2.22×10^{-8}	3.93×10^{-6}	2.71×10^{-7}
High-pressure spray fire on a Comet machine with a plutonium core	1.05×10^{-9}	1.09×10^{-6}	2.51×10^{-9}
Hydrogen detonation in SHEBA	1.69×10^{-7}	5.09×10^{-5}	1.97×10^{-6}
Earthquake-induced facility failures without fire	2.07×10^{-8}	7.92×10^{-6}	2.38×10^{-7}
Inadvertent solution criticality in SHEBA	9.25×10^{-14}	2.88×10^{-11}	7.16×10^{-13}

[a] Increased risk of a latent cancer fatality.
[b] Risk of increased number of latent cancer fatalities.
[c] Based on a population of 320,182 persons residing within 80 kilometers (50 miles) of the site.

Table C–7 Accident Frequency and Consequences under the TA-18 Upgrade Alternative

Accident	Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population [a]		Noninvolved Worker	
		Dose (rem)	Latent Cancer Fatalities [b]	Dose (person-rem)	Latent Cancer Fatalities [c]	Dose (rem)	Latent Cancer Fatalities [b]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	1.0×10^{-6}	0.0087	4.35×10^{-6}	2.58	0.00129	0.133	0.0000532
Bare, fully reflected or moderated metal criticality	0.0001	2.49×10^{-10}	1.25×10^{-13}	6.69×10^{-8}	3.34×10^{-11}	2.58×10^{-9}	1.03×10^{-12}
Uncontrolled reactivity insertion in SHEBA in burst mode	1.0×10^{-6}	22.2	0.0222	6,580	3.93	339	0.271
High-pressure spray fire on a Comet machine with a plutonium core	1.0×10^{-6}	0.209	0.000105	218	0.109	0.628	0.000251
Hydrogen detonation in SHEBA	0.0054	0.0625	0.0000313	18.8	0.00942	0.909	0.000364
Earthquake-induced facility failures without fire	0.0001	0.413	0.000207	158	0.0792	5.96	0.00238
Inadvertent solution criticality in SHEBA	1.0×10^{-6}	0.000185	9.25×10^{-8}	0.0575	0.0000288	0.00179	7.16×10^{-7}

[a] Based on a population of 320,182 persons residing within 80 kilometers (50 miles) of the site.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

Table C–8 Annual Cancer Risks Due to Accidents under the TA-18 Upgrade Alternative

Accident	Maximally Exposed Offsite Individual [a]	Offsite Population [b, c]	Noninvolved Worker [a]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	4.35×10^{-12}	1.29×10^{-9}	5.32×10^{-11}
Bare, fully reflected or moderated metal criticality	1.25×10^{-17}	3.34×10^{-15}	1.03×10^{-16}
Uncontrolled reactivity insertion in SHEBA in burst mode	2.22×10^{-8}	3.93×10^{-6}	2.71×10^{-7}
High-pressure spray fire on a Comet machine with a plutonium core	1.05×10^{-10}	1.09×10^{-7}	2.51×10^{-10}
Hydrogen detonation in SHEBA	1.69×10^{-7}	5.09×10^{-5}	1.97×10^{-6}
Earthquake-induced facility failures without fire	2.07×10^{-8}	7.92×10^{-6}	2.38×10^{-7}
Inadvertent solution criticality in SHEBA	9.25×10^{-14}	2.88×10^{-11}	7.16×10^{-13}

[a] Increased risk of a latent cancer fatality.
[b] Risk of increased number of latent cancer fatalities.
[c] Based on a population of 320,182 persons residing within 80 kilometers (50 miles) of the site.

Table C–9 Accident Frequency and Consequences under the LANL New Facility Alternative

Accident	Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population [a]		Noninvolved Worker	
		Dose (rem)	Latent Cancer Fatalities [b]	Dose (person-rem)	Latent Cancer Fatalities [c]	Dose (rem)	Latent Cancer Fatalities [b]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	1.0×10^{-6}	0.00334	1.67×10^{-6}	2.89	0.00144	1.53	0.000612
Bare, fully reflected or moderated metal criticality	0.0001	1.20×10^{-10}	6.0×10^{-14}	8.49×10^{-8}	4.24×10^{-11}	2.58×10^{-8}	1.03×10^{-11}
High-pressure spray fire on a Comet machine with a plutonium core	1.0×10^{-6}	0.121	0.0000605	181	0.0907	4.06	0.00162
Earthquake-induced facility failures without fire	0.0001	1.56×10^{-4}	7.8×10^{-8}	0.16	8.02×10^{-5}	0.0638	2.55×10^{-5}

[a] Based on a population of 283,571 persons residing within 80 kilometers (50 miles) of the site.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

Table C–10 Annual Cancer Risks Due to Accidents under the LANL New Facility Alternative

Accident	Maximally Exposed Offsite Individual [a]	Offsite Population [b, c]	Noninvolved Worker [a]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	1.67×10^{-12}	1.44×10^{-9}	6.12×10^{-10}
Bare, fully reflected or moderated metal criticality	6.0×10^{-18}	4.24×10^{-15}	1.03×10^{-15}
High-pressure spray fire on a Planet machine with a plutonium core	6.05×10^{-11}	9.07×10^{-8}	1.62×10^{-9}
Earthquake-induced facility failures without fire	7.8×10^{-12}	8.02×10^{-9}	2.55×10^{-9}

[a] Increased risk of a latent cancer fatality.
[b] Risk of increased number of latent cancer fatalities.
[c] Based on a population of 283,571 persons residing within 80 kilometers (50 miles) of the site.

Table C–11 Accident Frequency and Consequences under the SNL/NM Alternative

Accident	Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population [a]		Noninvolved Worker	
		Dose (rem)	Latent Cancer Fatalities [b]	Dose (person-rem)	Latent Cancer Fatalities [c]	Dose (rem)	Latent Cancer Fatalities [b]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	1.0×10^{-6}	0.000872	4.36×10^{-7}	5.25	0.00262	0.572	0.000229
Bare, fully reflected or moderated metal criticality	0.0001	3.20×10^{-11}	1.60×10^{-14}	1.47×10^{-7}	7.37×10^{-11}	9.91×10^{-9}	3.96×10^{-12}
High-pressure spray fire on a Comet machine with a plutonium core	1.0×10^{-6}	0.0331	0.0000166	433	0.216	6.91	0.00276
Earthquake-induced facility failures without fire	0.0001	3.67×10^{-5}	1.83×10^{-8}	0.291	1.45×10^{-4}	0.0257	1.03×10^{-5}

[a] Based on a population of 745,287 persons residing within 80 kilometers (50 miles) of the site.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

Table C–12 Annual Cancer Risks Due to Accidents under the SNL/NM Alternative

Accident	Maximally Exposed Offsite Individual [a]	Offsite Population [b, c]	Noninvolved Worker [a]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	4.36×10^{-13}	2.62×10^{-9}	2.29×10^{-10}
Bare, fully reflected or moderated metal criticality	1.60×10^{-18}	7.37×10^{-15}	3.96×10^{-16}
High-pressure spray fire on a Comet machine with a plutonium core	1.66×10^{-11}	2.16×10^{-7}	2.76×10^{-9}
Earthquake-induced facility failures without fire	1.83×10^{-12}	1.45×10^{-8}	1.03×10^{-9}

[a] Increased risk of a latent cancer fatality.
[b] Risk of increased number of latent cancer fatalities.
[c] Based on a population of 745,287 persons residing within 80 kilometers (50 miles) of the site.

Table C–13 Accident Frequency and Consequences under the NTS Alternative

Accident	Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population [a]		Noninvolved Worker	
		Dose (rem)	Latent Cancer Fatalities [b]	Dose (person-rem)	Latent Cancer Fatalities [c]	Dose (rem)	Latent Cancer Fatalities [b]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	1.0×10^{-6}	0.0000626	3.13×10^{-8}	0.016	8.00×10^{-6}	1.52	0.000608
Bare, fully reflected or moderated metal criticality	0.0001	2.18×10^{-12}	1.09×10^{-15}	2.47×10^{-10}	1.23×10^{-13}	2.52×10^{-8}	1.01×10^{-11}
High-pressure spray fire on a Comet machine with a plutonium core	1.0×10^{-6}	0.00497	2.49×10^{-6}	1.55	0.000773	1.00	0.004
Earthquake-induced facility failures without fire	0.0001	2.60×10^{-6}	1.30×10^{-9}	8.88×10^{-4}	4.44×10^{-7}	0.0638	2.55×10^{-5}

[a] Based on a population of 18,074 persons residing within 80 kilometers (50 miles) of the site.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

Table C–14 Annual Cancer Risks Due to Accidents under the NTS Alternative

Accident	Maximally Exposed Offsite Individual [a]	Offsite Population [b, c]	Noninvolved Worker [a]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	3.13×10^{-14}	8.00×10^{-12}	6.08×10^{-10}
Bare, fully reflected or moderated metal criticality	1.09×10^{-19}	1.23×10^{-17}	1.01×10^{-15}
High-pressure spray fire on a Comet machine with a plutonium core	2.49×10^{-12}	7.73×10^{-10}	4.00×10^{-9}
Earthquake-induced facility failures without fire	1.30×10^{-13}	4.44×10^{-11}	2.55×10^{-9}

[a] Increased risk of a latent cancer fatality.
[b] Risk of increased number of latent cancer fatalities.
[c] Based on a population of 18,074 persons residing within 80 kilometers (50 miles) of the site.

Table C–15 Accident Frequency and Consequences under the ANL/W Alternative

Accident	Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population [a]		Noninvolved Worker	
		Dose (rem)	Latent Cancer Fatalities [b]	Dose (person-rem)	Latent Cancer Fatalities [c]	Dose (rem)	Latent Cancer Fatalities [b]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	1.0×10^{-6}	0.000213	1.07×10^{-7}	0.162	0.0000811	1.15	0.00046
Bare, fully reflected or moderated metal criticality	0.0001	8.32×10^{-12}	4.20×10^{-15}	3.12×10^{-9}	1.56×10^{-12}	1.99×10^{-8}	7.96×10^{-12}
High-pressure spray fire on a Comet machine with a plutonium core	1.0×10^{-6}	0.0145	7.25×10^{-6}	15.4	0.00772	17.9	0.00716
Earthquake-induced facility failures without fire	0.0001	8.85×10^{-6}	4.42×10^{-9}	0.00902	4.51×10^{-6}	0.0485	1.94×10^{-5}

[a] Based on a population of 239,099 persons residing within 80 kilometers (50 miles) of the site.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

Table C–16 Annual Cancer Risks Due to Accidents under the ANL/W Alternative

Accident	Maximally Exposed Offsite Individual [a]	Offsite Population [b, c]	Noninvolved Worker [a]
Uncontrolled reactivity insertion in Comet or Planet with a plutonium core	1.07×10^{-13}	8.11×10^{-11}	4.60×10^{-10}
Bare, fully reflected or moderated metal criticality	4.20×10^{-19}	1.56×10^{-16}	7.96×10^{-16}
High-pressure spray fire on a Comet machine with a plutonium core	7.25×10^{-12}	7.72×10^{-9}	7.16×10^{-9}
Earthquake-induced facility failures without fire	4.42×10^{-13}	4.51×10^{-10}	1.94×10^{-9}

[a] Increased risk of a latent cancer fatality.
[b] Risk of increased number of latent cancer fatalities.
[c] Based on a population of 239,099 persons residing within 80 kilometers (50 miles) of the site.

Table C–17 Accident Frequency and Consequences under SHEBA Relocation

Accident	Frequency (per year)	Maximally Exposed Offsite Individual		Offsite Population [a]		Noninvolved Worker	
		Dose (rem)	Latent Cancer Fatalities [b]	Dose (person-rem)	Latent Cancer Fatalities [c]	Dose (rem)	Latent Cancer Fatalities [b]
Uncontrolled reactivity insertion in SHEBA in burst mode	1.0×10^{-6}	18.0	0.009	6,300	3.54	340	0.272
Hydrogen detonation in SHEBA	0.0054	0.0506	0.0000253	18.0	0.009	0.912	0.000365
Earthquake-induced facility failures without fire	0.0001	0.0315	0.0000158	14.3	0.00717	0.565	0.000226
Inadvertent solution criticality in SHEBA	1.0×10^{-6}	0.000139	6.95×10^{-8}	0.052	0.000026	0.00179	7.16×10^{-7}

[a] Based on a population of 450,302 persons residing within 80 kilometers (50 miles) of the site.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

Table C–18 Annual Cancer Risks Due to Accidents under SHEBA Relocation

Accident	Maximally Exposed Offsite Individual [a]	Offsite Population [b, c]	Noninvolved Worker [a]
Uncontrolled reactivity insertion in SHEBA in burst mode	9.0×10^{-9}	3.45×10^{-6}	2.72×10^{-7}
Hydrogen detonation in SHEBA	1.37×10^{-7}	4.87×10^{-5}	1.97×10^{-6}
Earthquake-induced facility failures without fire	1.58×10^{-9}	7.17×10^{-7}	2.26×10^{-8}
Inadvertent solution criticality in SHEBA	6.95×10^{-14}	2.60×10^{-11}	7.16×10^{-13}

[a] Increased risk of a latent cancer fatality.
[b] Risk of increased number of latent cancer fatalities.
[c] Based on a population of 450,302 persons residing within 80 kilometers (50 miles) of the site.

C.6 ANALYSIS CONSERVATISM AND UNCERTAINTY

The analysis of accidents is based on calculations relevant to hypothetical sequences of events and models of their effects. The models provide estimates of the frequencies, source terms, pathways for dispersion, exposures, and the effects on human health and the environment as realistic as possible within the scope of the analysis. In many cases, the scarcity of experience with the postulated accidents leads to uncertainty in the calculation of the consequences and frequencies. This fact has promoted the use of models or input values that yield conservative estimates of consequences and frequency.

Due to the layers of conservatism built into the accident analysis for the spectrum of postulated accidents, the estimated consequences and risks to the public represent the upper limit for the individual classes of accidents. The uncertainties associated with the accident frequency estimates are enveloped by the analysis conservatism.

Of particular interest are the uncertainties in the estimates of cancer fatalities from exposure to radioactive materials. The numerical values of the health risk estimators used in this EIS were obtained by linear extrapolation from the nominal risk estimate for lifetime total cancer mortality resulting from exposures of 10 rad. Because the health risk estimators are multiplied by conservatively calculated radiological doses to predict fatal cancer risks, the fatal cancer values presented in this EIS are expected to be overestimates.

For the purposes of this EIS, the impacts calculated from the linear model are treated as an upper-bound case, consistent with the widely used methodologies for quantifying radiogenic health impacts. This does not imply that health effects are expected. Moreover, in cases where the upper-bound estimators predict a number of latent cancer fatalities greater than 1, this does not imply that the latent cancer fatality risk can be determined for a specific individual.

C.7 Industrial Safety

Estimates of potential industrial impacts on workers during construction and operations were evaluated based on DOE and U.S. Bureau of Labor Statistics. Impacts are classified into two groups, total recordable cases and fatalities. A recordable case includes work-related fatality, illness, or injury that resulted in loss of consciousness, restriction of work or motion, transfer to another job, or required medical treatment beyond first aid.

DOE and contractor total recordable cases and fatality incidence rates were obtained from the CAIRS database (DOE 2000a, 2000b). The CAIRS database is used to collect and analyze DOE and DOE contractor reports of injuries, illnesses, and other accidents that occur during DOE operations. The five-year average (1995 through 1999) rates were determined for average construction total recordable cases, average operations total recordable cases, and average operations fatalities. The average construction fatality rate was obtained from the Bureau of Labor Statistics (Toscano and Windau 1998).

Table C–19 presents the average occupational total recordable cases and fatality rates for construction and operations activities.

Table C–19 Average Occupational Total Recordable Cases and Fatality Rates (per worker year)

Labor Category	*Total Recordable Cases*	*Fatalities*
Construction	0.053	0.000139
Operations	0.033	0.000013

Expected annual construction and operations impacts on workers for each alternative are presented in **Table C–20**.

Table C–20 Industrial Safety Impacts from Construction and Operations (per year)

Alternative	*Estimated Number of Construction Workers*	*Estimated Number of Operations Workers*	*Construction Injuries*	*Construction Fatalities*	*Operations Injuries*	*Operations Fatalities*
No Action	0	212	0.0	0.0	7.00	0.003
TA-18 Upgrade	110	212	5.83	0.015	7.00	0.003
LANL New Facility	300	100	15.9	0.042	3.30	0.001
SNL/NM	300	100	15.9	0.042	3.30	0.001
NTS	60	100	3.18	0.008	3.30	0.001
ANL-W	120	100	6.36	0.017	3.30	0.001
Relocation of Security Category III/IV and SHEBA	70	110	3.71	0.010	3.63	0.001

As expected, the incidence of impacts, above and beyond those requiring first aid, do indeed exceed impacts from radiation accidents evaluated in this analysis. However, no fatalities would be expected from either construction or operations of any facility.

C.8 MACCS2 Code Description

The MACCS2 computer code is used to estimate the radiological doses and health effects that could result from postulated accidental releases of radioactive materials to the atmosphere. The specification of the release characteristics, designated a "source term," can consist of up to four Gaussian plumes that are often referred to simply as "plumes."

The radioactive materials released are modeled as being dispersed in the atmosphere while being transported by the prevailing wind. During transport, whether or not there is precipitation, particulate material can be modeled as being deposited on the ground. If contamination levels exceed a user-specified criterion, mitigative actions can be triggered to limit radiation exposures.

There are two aspects of the code's structure that are basic to understanding its calculations: (1) the calculations are divided into modules and phases, and (2) the region surrounding the facility is divided into a polar-coordinate grid. These concepts are described in the following sections.

MACCS is divided into three primary modules: ATMOS, EARLY, and CHRONC. Three phases are defined as the emergency, intermediate, and long-term phases. The relationship among the codes's three modules and the three phases of exposure are summarized below.

The ATMOS module performs all of the calculations pertaining to atmospheric transport, dispersion, and deposition, as well as the radioactive decay that occurs before release and while the material is in the atmosphere. It uses a Gaussian plume model with Pasquill-Gifford dispersion parameters. The phenomena treated include building wake effects, buoyant plume rise, plume dispersion during transport, wet and dry deposition, and radioactive decay and ingrowth. The results of the calculations are stored for use by EARLY and CHRONC. In addition to the air and ground concentrations, ATMOS stores information on wind direction, arrival and departure times, and plume dimensions.

The EARLY module models the time period immediately following a radioactive release. This period is commonly referred to as the emergency phase. The emergency phase begins at each successive downwind distance point when the first plume of the release arrives. The duration of the emergency phase is specified by the user, and it can range between one and seven days. The exposure pathways considered during this period are direct external exposure to radioactive material in the plume (cloudshine); exposure from inhalation of radionuclides in the cloud (cloud inhalation); exposure to radioactive material deposited on the ground (groundshine); inhalation of resuspended material (resuspension inhalation); and skin dose from material deposited on the skin. Mitigative actions that can be specified for the emergency phase include evacuation, sheltering, and dose-dependent relocation.

The CHRONC module performs all of the calculations pertaining to the intermediate and long-term phases. CHRONC calculates the individual health effects that result from both direct exposure to contaminated ground and from inhalation of resuspended materials, as well as indirect health effects caused by the consumption of contaminated food and water by individuals who could reside both on and off the computational grid.

The intermediate phase begins at each successive downwind distance point upon the conclusion of the emergency phase. The user can configure the calculations with an intermediate phase that has a duration as short as zero or as long as one year. In the zero-duration case, there is essentially no intermediate phase and a long-term phase begins immediately upon conclusion of the emergency phase.

Intermediate models are implemented on the assumption that the radioactive plume has passed and the only exposure sources (groundshine and resuspension inhalation) are from ground-deposited material. It is for this reason that MACCS2 requires the total duration of a radioactive release be limited to no more than four days. Potential doses from food and water during this period are not considered.

The mitigative action model for the intermediate phase is very simple. If the intermediate phase dose criterion is satisfied, the resident population is assumed to be present and subject to radiation exposure from groundshine and resuspension for the entire intermediate phase. If the intermediate phase exposure exceeds the dose criterion, then the population is assumed to be relocated to uncontaminated areas for the entire intermediate phase.

The long-term phase begins at each successive downwind distance point upon the conclusion of the intermediate phase. The exposure pathways considered during this period are groundshine, resuspension inhalation, and food and water ingestion.

The exposure pathways considered are those resulting from ground-deposited material. A number of protective measures, such as decontamination, temporary interdiction, and condemnation, can be modeled in the long-term phase to reduce doses to user-specified levels. The decisions on mitigative action in the long-term phase are based on two sets of independent actions: (1) decisions relating to whether land at a specific location and time is suitable for human habitation (habitability), and (2) decisions relating to whether land at a specific location and time is suitable for agricultural production (farmability).

All of the calculations of MACCS2 are stored on the basis of a polar-coordinate spatial grid with a treatment that differs somewhat between calculations of the emergency phase and calculations of the intermediate and long-term phases. The region potentially affected by a release is represented with a (r, Θ) grid system centered on the location of the release. The radius, r, represents downwind distance. The angle, Θ, is the angular offset from north, going clockwise.

The user specifies the number of radial divisions as well as their endpoint distances. The angular divisions used to define the spatial grid are fixed in the code and correspond to the 16 points of the compass, each being 22.5 degrees wide. The 16 points of the compass are used in the United States to express wind direction. The compass sectors are referred to as the coarse grid.

Since emergency phase calculations use dose-response models for early fatalities and early injuries that can be highly nonlinear, these calculations are performed on a finer grid basis than the calculations of the intermediate and long-term phases. For this reason, the calculations of the emergency phase are performed with the 16 compass sectors divided into three, five, or seven equal, angular subdivisions. The subdivided compass sectors are referred to as the fine grid.

Two types of doses may be calculated by the code, "acute" and "lifetime."

Acute doses are calculated to estimate deterministic health effects that can result from high doses delivered at high dose rates. Such conditions may occur in the immediate vicinity of a nuclear facility following hypothetical severe accidents where confinement and/or containment failure has been assumed to occur. Examples of the health effects based on acute doses are early fatality, prodromal vomiting, and hypothyroidism.

Lifetime doses are the conventional measure of detriment used for radiological protection. These are 50-year dose commitments to either specific tissues (e.g., red marrow and lungs) or a weighted sum of tissue doses defined by the International Commission on Radiological Protection and referred to as "effective dose."

Lifetime doses may be used to calculate the stochastic health effect risk resulting from exposure to radiation. MACCS2 uses the calculated lifetime dose in cancer risk calculations.

C.9 REFERENCES

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APPENDIX D

Human Health Effects from Transportation

TA-18

APPENDIX D
HUMAN HEALTH EFFECTS FROM TRANSPORTATION

D.1 Introduction

Transportation of any commodity involves a risk to both transportation crew members and members of the public. This risk results directly from transportation-related accidents and indirectly from the increased levels of pollution from vehicle emissions, regardless of the cargo. The transportation of certain materials, such as hazardous or radioactive waste, can pose an additional risk due to the unique nature of the material itself. To permit a complete appraisal of the environmental impacts of the proposed action and alternatives, the human health risks associated with the transportation of TA-18 nuclear materials are assessed.

This appendix provides an overview of the approach used to assess the human health risks that may result from transportation. The topics in this appendix include the scope of the assessment, packaging and determination of potential transportation routes, analytical methods used for the risk assessment (e.g., computer models), and important assessment assumptions. It also presents the results of the assessment. In addition, to aid in the understanding and interpretation of the results, specific areas of uncertainty are described with an emphasis on how the uncertainties may affect comparisons of the alternatives.

The risk assessment results are presented in this appendix in terms of "per-shipment" risk factors, as well as for the total risks for a given alternative. Per-shipment risk factors provide an estimate of the risk from a single shipment. The total risks for a given alternative are found by multiplying the expected number of shipments by the appropriate per-shipment risk factors.

D.2 Scope of Assessment

The scope of the transportation human health risk assessment, including the alternatives and options, transportation activities, potential radiological and nonradiological impacts, and transportation modes considered, is described below. Additional details of the assessment are provided in the remaining sections of the appendix.

Proposed Action and Alternatives

The transportation risk assessment conducted for this environmental impact statement (EIS) estimates the human health risks associated with the transportation of radioactive and special nuclear material currently stored at TA-18. Consistent with the scope of the transportation human health risks, this evaluation focuses on using onsite and offsite public highways. Impacts associated with onsite transportation of material in support of the LANL New Facility Alternative are addressed qualitatively. Impacts associated with offsite transportation of materials to SNL/NM, NTS and ANL-W are quantitatively evaluated.

Transportation-Related Activities

The transportation risk assessment is limited to estimating the human health risks related to transportation for each alternative. The risks to workers or to the public during loading, unloading, and handling prior to or after shipment are included in the transportation assessment. The transportation risk assessment does not address possible impacts from increased transportation levels on local traffic flow, noise levels, or infrastructure.

Radiological Impacts

For each alternative, radiological risks (i.e., those risks that result from the radioactive nature of the materials) are assessed for both incident-free (i.e., normal) and accident transportation conditions. The radiological risk associated with incident-free transportation conditions would result from the potential exposure of people to external radiation in the vicinity of a shipment. The radiological risk from transportation accidents would come from the potential release and dispersal of radioactive material into the environment during an accident and the subsequent exposure of people.

All radiological impacts are calculated in terms of committed dose and associated health effects in the exposed populations. The radiation dose calculated is the total effective dose equivalent (see 10 CFR 20), which is the sum of the effective dose equivalent from external radiation exposure and the 50-year committed effective dose equivalent from internal radiation exposure. Radiation doses are presented in units of roentgen equivalent man (rem) for individuals and person-rem for collective populations. The impacts are further expressed as health risks in terms of latent cancer fatalities and cancer incidence in exposed populations using the dose-to-risk conversion factors established by the National Council on Radiation Protection and Measurement (NCRP 1993).

Nonradiological Impacts

In addition to the radiological risks posed by transportation activities, vehicle-related risks are also assessed for nonradiological causes (i.e., causes related to the transport vehicles and not the radioactive cargo) for the same transportation routes. The nonradiological transportation risks, which would be incurred for similar shipments of any commodity, are assessed for both incident-free and accident conditions. The nonradiological risks during incident-free transportation conditions would be caused by potential exposure to increased vehicle exhaust emissions. The nonradiological accident risk refers to the potential occurrence of transportation accidents that directly result in fatalities unrelated to the shipment of cargo. Nonradiological risks are presented in terms of estimated fatalities.

Transportation Modes

All shipments are assumed to take place by truck transportation modes. Rail transportation is not practical at TA-18 or any of the potential receiving sites, and the U.S. Department of Energy (DOE) has considerably more experience safeguarding special nuclear material on the highways.

Receptors

Transportation-related risks are calculated and presented separately for workers and members of the general public. The workers considered are truck crew members involved in the actual transportation and the site workers involved in repackaging, loading and unloading the materials. The general public includes all persons who could be exposed to a shipment while it is moving or stopped during transit. The affected population includes individuals living within 800 meters (0.5 miles) of each side of the road. Potential risks are estimated for the affected populations and for the hypothetical maximally exposed individual. For incident-free operation, the maximally exposed individual would be an individual stuck in traffic next to the shipment for 30 minutes. For accident conditions, the maximally exposed individual would be an individual located 33 meters (108 feet) directly downwind from the accident. The risk to the affected population is a measure of the radiological risk posed to society as a whole by the alternative being considered. As such, the impact to the affected population is used as the primary means of comparing various alternatives.

D.3 PACKAGING AND REPRESENTATIVE SHIPMENT CONFIGURATIONS

Regulations that govern the transportation of radioactive materials are designed to protect the public from the potential loss or dispersal of radioactive materials, as well as from routine radiation doses during transit. The primary regulatory approach to promote safety is the specification of standards for the packaging of radioactive materials. Because packaging represents the primary barrier between the radioactive material being transported and radiation exposure to the public and the environment, packaging requirements are an important consideration for transportation risk assessment. Regulatory packaging requirements applicable to the TA-18 radioactive and special nuclear material (SNM) are discussed below. The representative packaging and shipment configurations assumed for this EIS also are described below.

D.3.1 Packaging Overview

Although several Federal and state organizations are involved in the regulation of radioactive material transportation, primary regulatory responsibility resides with the U.S. Department of Transportation and the U.S. Nuclear Regulatory Commission (NRC). All transportation activities must take place in accordance with the applicable regulations of these agencies as specified in 49 CFR 172 and 173 and 10 CFR 71.

Transportation packaging for small quantities of radioactive materials must be designed, constructed, and maintained to contain and shield their contents during normal transport conditions. For large quantities and for more highly radioactive material, such as high-level radioactive waste or spent nuclear fuel, they must contain and shield their contents in the event of severe accident conditions. The type of packaging used is determined by the total radioactive hazard presented by the material within the packaging. Four basic types of packaging are used: Excepted, Industrial, Type A, and Type B. Another packaging option, "Strong, Tight," is still available for some domestic shipments.

Excepted packages are limited to transporting materials with extremely low-levels of radioactivity. Industrial packages are used to transport materials that, because of their low concentration of radioactive materials, present a limited hazard to the public and the environment. Type A packages are designed to protect and retain their contents under normal transport conditions and must maintain sufficient shielding to limit radiation exposure to handling personnel. These packages are used to transport radioactive materials with higher concentrations or amounts of radioactivity than Excepted, or Industrial packages. Strong, Tight packages are used in the United States for shipment of certain materials with low-levels of radioactivity, such as natural uranium and rubble from the decommissioning of nuclear reactors. Type AF packages (the "F" stands for fissile material) are designed to carry material with relatively low radioactivity levels with additional requirements to prevent a fission chain reaction under severe transportation conditions. Type B packages are used to transport material with the highest radioactivity levels, are designed to protect and retain their contents under transportation accident conditions, and are described in more detail in the following sections.

D.3.2 Regulations Applicable to Type B Casks

Regulations for the transport of radioactive materials in the United States are issued by the U.S. Department of Transportation and are codified in 49 CFR 173. The regulation authority for radioactive materials transport is jointly shared by the Department of Transportation and the NRC. As outlined in a 1979 Memorandum of Understanding with the NRC, the U.S. Department of Transportation specifically regulates the carriers of radioactive materials and the conditions of transport, such as routing, handling and storage, and vehicle and driver requirements. The U.S. Department of Transportation also regulates the labeling, classification, and marking of all radioactive material packages. The U.S. Department of Transportation also has a specification for one Type B package, the 6M, that could be used to transport TA-18 materials. NRC sets the standards for packages containing Type B quantities of radioactive material, fissile materials and spent nuclear fuel.

DOE policy requires compliance with applicable Federal regulations regarding domestic shipments of radioactive materials. Accordingly, DOE has adopted the requirements of 10 CFR 71, *Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions*, and 49 CFR 173, *Shippers--General Requirements for Shipping and Packaging*. DOE Headquarters can issue a certificate of compliance for a package to be used only by DOE and its contractors. Packages certified by NRC, certified by DOE or specified by the U.S. Department of Transportation could be used to transport TA-18 material.

For certification, transportation casks must be shown by analysis and/or testing to withstand a series of hypothetical accident conditions. These conditions have been internationally accepted as simulating damage to transportation casks that could occur in most reasonably foreseeable accidents. The impact, fire, and water-immersion tests are considered in sequence to determine their cumulative effects on one package. These accident conditions are described in **Figure D–1**.

Under the Federal certification program, a Type B packaging design must be supported by a Safety Analysis Report for Packaging (SARP), which demonstrates that the design meets Federal packaging standards. The SARP must include a description of the proposed packaging in sufficient detail to identify the packaging accurately and provide the basis for evaluating its design. The SARP must provide the evaluation of the structural design, materials' properties, containment boundary, shielding capabilities, and criticality control, and present the operating procedures, acceptance testing, maintenance program, and the quality assurance program to be used for design and fabrication. Upon completion of a satisfactory review of the SARP to verify compliance with the regulations, a Certificate of Compliance is issued. For risk assessment purposes, it is important to note that all packaging of a given type is designed to meet the same performance criteria. Therefore, two different Type B designs would be expected to perform similarly during incident-free and accident transportation conditions.

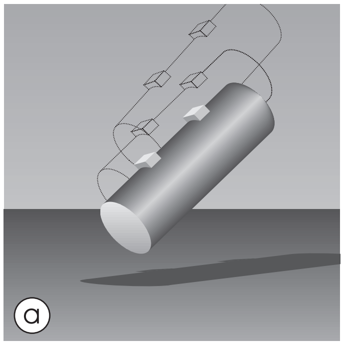
D.3.3 External Radiation Limits

External radiation from a package must be below specified limits that minimize the exposure of handling personnel and the general public. For these types of shipments, the external radiation dose rate during normal transportation conditions must be maintained below the following limits of 49 CFR 173:

- 10 millirem per hour at any point 2 meters (6.6 feet) from the vertical planes projected by the outer lateral surfaces of the transport vehicle (referred to as the regulatory limit throughout this document), and

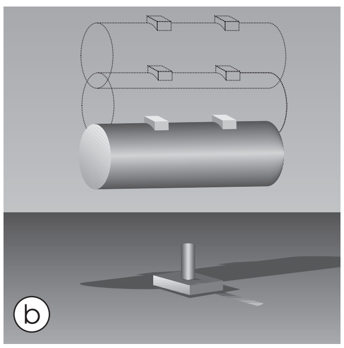
- 2 millirem per hour in any normally occupied position in the transport vehicle

Additional restrictions apply to package surface contamination levels, but these restrictions are not important for the transportation radiological risk assessment. Current contamination standards assure that workers and public receive doses much lower than those associated with radiation emitted from the packages.



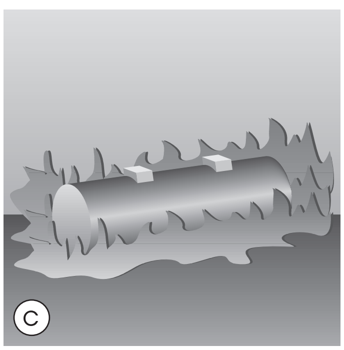
Standards for Type B Casks

For certification to the U.S. Nuclear Regulatory Commission standards, a cask must be shown by test or analysis to withstand a series of accident conditions without releasing its contents. These conditions have been internationally accepted as simulating damage to spent nuclear fuel casks that could occur in most severe credible accidents. The impact, fire, and water-immersion tests are considered in sequence to determine their cumulative effects on one package. An undamaged containment system is subjected to a deep water-immersion test. The details of the tests are as follows:



Impact

Free Drop (a) – The cask drops 9 meters (30 feet) onto a flat, horizontal, unyielding surface so that it strikes at its weakest point.

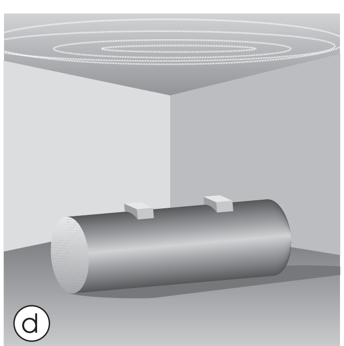


Puncture (b) – The cask drops 1 meter (40 inches) onto a 15.2-centimeter (6-inch) diameter steel bar at least 20.3 centimeters (8 inches) long; the bar strikes the cask at its most vulnerable spot.

Fire (c)

After the impact tests, the cask is totally engulfed in an 802 °C (1,475 °F) thermal environment for 30 minutes.

Water Immersion (d)



The cask is completely submerged under at least 1 meter (40 inches) of water for 8 hours. Additionally, undamaged containment systems (casks) are required to withstand more rigorous immersion tests.

Figure D–1 Standards for Transportation Casks

D.4 GROUND TRANSPORTATION ROUTE SELECTION PROCESS

According to DOE guidelines, radioactive material shipments must comply with both the NRC and the U.S. Department of Transportation regulatory requirements. NRC regulations cover the packaging and transport of radioactive materials, whereas DOT specifically regulates the carriers and the conditions of transport, such as routing, handling and storage, and vehicle and driver requirements. The highway routing of nuclear material is systematically determined according to the U.S. Department of Transportation regulation 49 CFR 397 for commercial shipments. Specific routes cannot be publicly identified in advance for DOE's Transportation Safeguards Division's shipments because they are classified to protect national security interests.

The U.S. Department of Transportation routing regulations require that shipments of highway route-controlled quantities of radioactive material be transported over a preferred highway network, including interstate highways, with preference toward interstate system bypasses and beltways around cities and state-designated preferred routes. A state or tribe may designate a preferred route to replace or supplement the interstate highway system in accordance with the U.S. Department of Transportation guidelines (49 CFR Section 397.103).

Carriers of highway route-controlled quantities are required to use the preferred network unless they are moving from their origin to the nearest interstate highway or from the interstate highway to their destination, they are making necessary repair or rest stops, or emergency conditions render the interstate highway unsafe or impassable. The primary criterion for selecting the preferred route for a shipment is travel time. Preferred routing takes into consideration accident rate, transit time, population density, activities, time of day, and day of the week.

Representative routes that may be used for the shipments were selected for risk assessment purposes using the HIGHWAY code. They do not necessarily represent the actual routes that would be used to transport nuclear materials. The selection of the actual route would be responsive to environmental and other conditions that would be in effect or could be predicted at the time of shipment. Such conditions could include adverse weather conditions, road conditions, bridge closures, and local traffic problems. For security reasons, details about a route would not be publicized before the shipment.

The HIGHWAY computer code (Johnson et al. 1993) is used for selecting highway routes in the United States. The HIGHWAY database is a computerized road atlas that currently describes over 386,000 kilometers (240,000 miles) of roads. The Interstate System and all U.S. (US-designated) highways are completely described in the database. In addition, most of the principal state highways and many local and community roads are also identified. The code is updated periodically to reflect current road conditions and has been benchmarked against reported mileages and observations of commercial truck firms. Features in the HIGHWAY code allow the user to select routes that conform to U.S. Department of Transportation regulations. Additionally, the HIGHWAY code contains data on the population densities along the routes. The distances and populations from the HIGHWAY code are part of the information used for the transportation impact analysis in this TA-18 Relocation EIS.

D.5 SAFEGUARDED TRANSPORTATION

DOE anticipates that any transportation of SNM would be required to be made through use of the Transportation Safeguards System and shipped using Safe, Secure Trailers/Safeguards Transports (SST/SGTs). Transportation safeguards are required for (1) nuclear explosives; (2) components moved in a single shipment that could comprise a complete nuclear explosive; (3) any form of uranium-235 enriched 20 percent or greater in quantities of 5 kilograms (11 pounds) or more, or uranium-233 or plutonium in quantities of 2 kilograms (4.4 pounds) or more; (4) classified forms of plutonium and uranium-235 regardless of quantity as requested by Heads of Field Elements; (5) DOE-owned plutonium in any quantity to be transported by air; or (6) any form of plutonium-238 in excess of 5 grams (0.18 ounce) (DOE Order Supplemental Directive AL 5610.14). The SST/SGT is a fundamental component of the Transportation Safeguards System.

The SST/SGT is a specially designed component of an 18-wheel tractor-trailer vehicle. While 49 CFR Section 173.7(b) exempts SST/SGT shipments from U.S. Department of Transportation regulations, DOE operates and maintains these vehicles in a way that exceeds U.S. Department of Transportation requirements. Although details of vehicle enhancements and some operational aspects are classified, key characteristics of the SST/SGT system include the following:

- Enhanced structural characteristics and a highly-reliable tie-down system to protect cargo from impact.
- Heightened thermal resistance to protect the cargo in case of fire (newer SST/SGT models).
- Established operational and emergency plans and procedures governing the shipment of nuclear materials.
- Various deterrents to prevent unauthorized removal of cargo.
- An armored tractor component that provides courier protection against attack and contains advanced communications equipment.
- Specially designed escort vehicles containing advanced communications and additional couriers.
- 24-hour-a-day real-time communications to monitor the location and status of all SST/SGT shipments via DOE's Security Communication system.
- Couriers, who are armed Federal officers, receive rigorous specialized training and are closely monitored through DOE's Personnel Assurance Program.
- Significantly more stringent maintenance standards than those for commercial transport equipment.
- Conduct of periodic appraisals of the Transportation Safeguards System operations by the DOE Office of Defense Programs to ensure compliance with DOE orders and management directives, and continuous improvement in transportation and emergency management programs.

The Transportation Safeguards System is operated by the DOE Transportation Safeguards Division of the Albuquerque Operations Office for the DOE Headquarters Office of Defense Programs. Based on operational experience between fiscal year 1984 and fiscal year 1998, the mean probability of an accident requiring the tow-away of the SST/SGT was 0.058 accidents per million kilometers (0.096 accidents per million miles) (Claus and Shyr 1999). By contrast, the rate for commercial trucking in 1989 was about 0.3 accidents per million kilometers (0.5 accidents per million miles) (Saricks and Tompkins 1999). Accident rates for commercial trucking and SST/SGTs were used in the human health effects analysis. Since its establishment in 1975, the Transportation Safeguards Division has accumulated more than 151 million kilometers (94 million miles) of over-the-road experience transporting DOE-owned cargo with no accidents resulting in a fatality or release of radioactive material.

Loading and unloading of SST/SGTs at DOE sites is routinely done in accordance with site facility and Transportation Safeguards Division procedures. The DOE SST/SGT operations team directs and approves loading and securing of packages within SST/SGT vehicles and is solely responsible for closing and securing SST/SGT vehicles and cargo areas prior to transport.

Task interactions between Transportation Safeguards Division operations teams, the SST/SGT operations center, the shipping and receiving sites, and security personnel involved in loading, securing, and dispatching SST/SGT shipments are conducted in accordance with the requirements of DOE Orders 461.1, 5632.1C, and 474.1 and SST/SGT operations procedures. In dispatching shipments, DOE's SST operations team and operations center also coordinate with the security operations center at a DOE site. Estimated time of arrival, shipment, and material accountability information is transmitted to designated persons at the receiving site in accordance with prearranged protocols. DOE anticipates the time necessary to prepare, load, secure, and dispatch SST/SGTs to be on the order of less than 1 day (per convoy).

SGT and SST have similar dimensions. The general dimensions for SST are given below (Ludwig et al. 1997):

Gross vehicle weight rating	36,288 kilograms (80,000 pounds)
Maximum payload	6,169 kilograms (13,600 pounds)
Trailer overall length	18.3 meters (60 feet)
Trailer overall width	259 centimeters (102 inches)
Trailer overall height	4 meters (13 feet)
Trailer rear door width	179.1 to 215.9 centimeters (70.5 to 85 inches)
Trailer rear door height	229 centimeters (90 inches)
Trailer floor height above roadway	144 centimeters (56.5 inches)
Tractor trailer minimum turning radius	11.4 meters (37.5 feet)

D.6 TRANSPORTATION IMPACT ANALYSIS METHODOLOGY

The transportation risk assessment is based on the alternatives described in Chapter 3 of this EIS. After the EIS alternatives were identified, and the requirements of the shipping campaign were understood, data was collected on the material characteristics and accident parameters. Section D.7 describes these parameters. **Figure D–2** summarizes the transportation risk assessment methodology.

Transportation impacts calculated in this EIS are presented in two parts: impacts from incident-free or routine transportation, and impacts from transportation accidents. Impacts from incident-free transportation and transportation accidents were further divided into nonradiological and radiological impacts. Nonradiological impacts from incident-free transportation would be impacts from vehicular emissions and from transportation accidents would be traffic fatalities. Radiological impacts from incident-free transportation include impacts to members of the public and crew from radiation emanating from materials within the package. Only under worst case accident conditions, which are of low probability of occurrence, could a transportation package of the type used to transport radioactive and SNM be damaged to the point that radioactivity could be released to the environment.

The impact of transportation accidents is expressed in terms of probabilistic risk, which is the probability of an accident multiplied by the consequences of that accident and summed over all reasonably conceivable accident conditions. Hypothetical transportation accident conditions ranging from low-speed "fender-bender" collisions to high-speed collisions with or without fires were analyzed. The frequencies of accidents and consequences were evaluated using a method developed by the NRC and originally published in NUREG-0170 (NRC 1977). The risk of radiological accidents is expressed in terms of additional latent

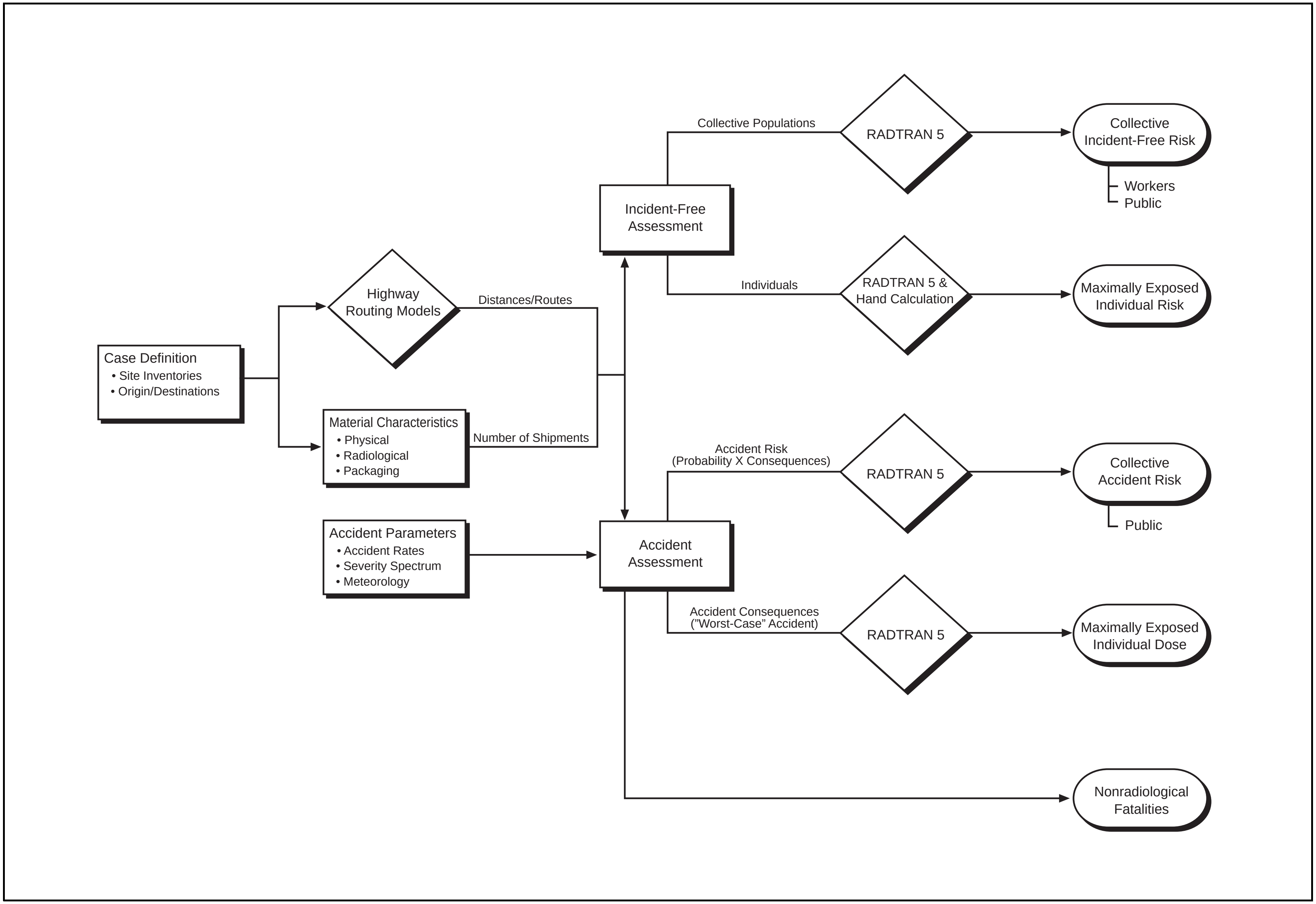


Figure D–2 Overland Transportation Risk Assessment

cancer fatalities and risk of nonradiological accidents is expressed in terms of additional immediate fatalities. Incident-free risks are also expressed in terms of additional latent cancer fatalities.

Transportation-related risks are calculated and presented separately for workers and members of the general public. The workers considered are truck crew members involved in the actual transportation, and workers involved in the packaging, loading, unloading and unpacking of TA-18 material. The general public includes all persons who could be exposed to a shipment while it is moving or stopped during transit.

The first step in the ground transportation analysis is to determine the distances and populations along the routes. The HIGHWAY (Johnson et al. 1993) computer code was used to choose representative routes and the associated distance and population. This information, along with the properties of the material being shipped and route-specific accident frequencies, was entered into the RADTRAN 5 computer code (Neuhauser and Kanipe 2000), which calculated incident and accident risks on a per-shipment basis. The per-shipment risks are multiplied by the number of shipments to determine the risk for each alternative. The doses to TA-18 workers are estimated in a separate analysis.

The RADTRAN 5 computer code (Neuhauser and Kanipe 2000) is used for incident-free and accident risk assessments to estimate the impacts on population. RADTRAN 5 was developed by Sandia National Laboratories to calculate population risks associated with the transportation of radioactive materials by a variety of modes, including truck, rail, air, ship, and barge. RADTRAN 5 was used to calculate the doses to the maximally exposed individuals.

The RADTRAN 5 population risk calculations include both the consequences and probabilities of potential exposure events. The RADTRAN 5 code consequence analyses include cloud shine, ground shine, inhalation, and resuspension exposures. The collective population risk is a measure of the total radiological risk posed to society as a whole by the alternative being considered. As such, the collective population risk is used as the primary means of comparing the various alternatives.

D.7 TRANSPORTATION ANALYSIS, PARAMETERS, AND ASSUMPTIONS

D.7.1 Material Inventory and Shipping Campaigns

The materials that would be transported under each alternative include approximately 2.4 metric tons (2.6 tons) of SNM and 10 metric tons (11 tons) of depleted natural uranium and thorium. The SNM would consist of uranium in all forms and enrichments and plutonium (mostly metals, double-encapsulated or clad) with a wide variety of contents including plutonium-240, uranium-233, neptunium-237, and other isotopic sources. The materials would be in various chemical (metals, oxides, alloys, etc.) and geometric (sphere, shell, cylinders, rings, plates, and others) forms specific to the experiments in support of the TA-18 operations. Since the specifics of isotopic composition and the shape of the materials to be transported are classified, for the purposes of analysis in this EIS, the SNM inventory has been converted to an equivalent amount of plutonium-239. The conversion is on a constant consequence-basis, so the consequences calculated in the accident analyses are exactly the same as they would be if the actual material inventory were used. The equivalent inventory of plutonium-239 to be transported in support of the TA-18 relocation is approximately 1,000 kilograms (2,205 pounds).

DOE has performed a survey of materials to be transported and has identified a preliminary estimate of the packaging and transportation needs. DOE has identified that the materials would be packaged in either a Type AF, in a Type B, in a Defense Program weapon component, or in a U.S. Department of Transportation specification packaging. The packages include SAFKEG, DT-22, DT-23, Model FL, ES-2100, and 6M. Some of the proposed packages would require additional analysis and modifications to Certificates of

Compliance. Before shipping any materials, DOE would document compliance with the Federal regulations in effect at the time of the shipment. Most of the material currently stored at TA-18 can be accommodated within current and proposed DOE-owned packages or readily available commercial packages. However, since shipments would not be carried out for several years, some existing packages may be retired and substitute packages identified.

DOE has not yet completed a package-by-package, shipment-by-shipment plan for relocating TA-18 materials. This will not be performed until after an alternative is selected and the Record of Decision is published. Since the isotopic composition and shape of some of the materials are classified, part of this plan would have to be classified. DOE's preliminary analysis of the shipping requirements indicates a need for 87 SST/SGT shipments (Lanthrum 2001) of assorted radioactive and SNM (enriched uranium, plutonium, and other fissile isotopes) and 5 truck shipments for machines, depleted and natural uranium, and thorium, for a total of 92 shipments.

D.7.2 General Description of Packages Selected for Transportation of Nuclear Materials

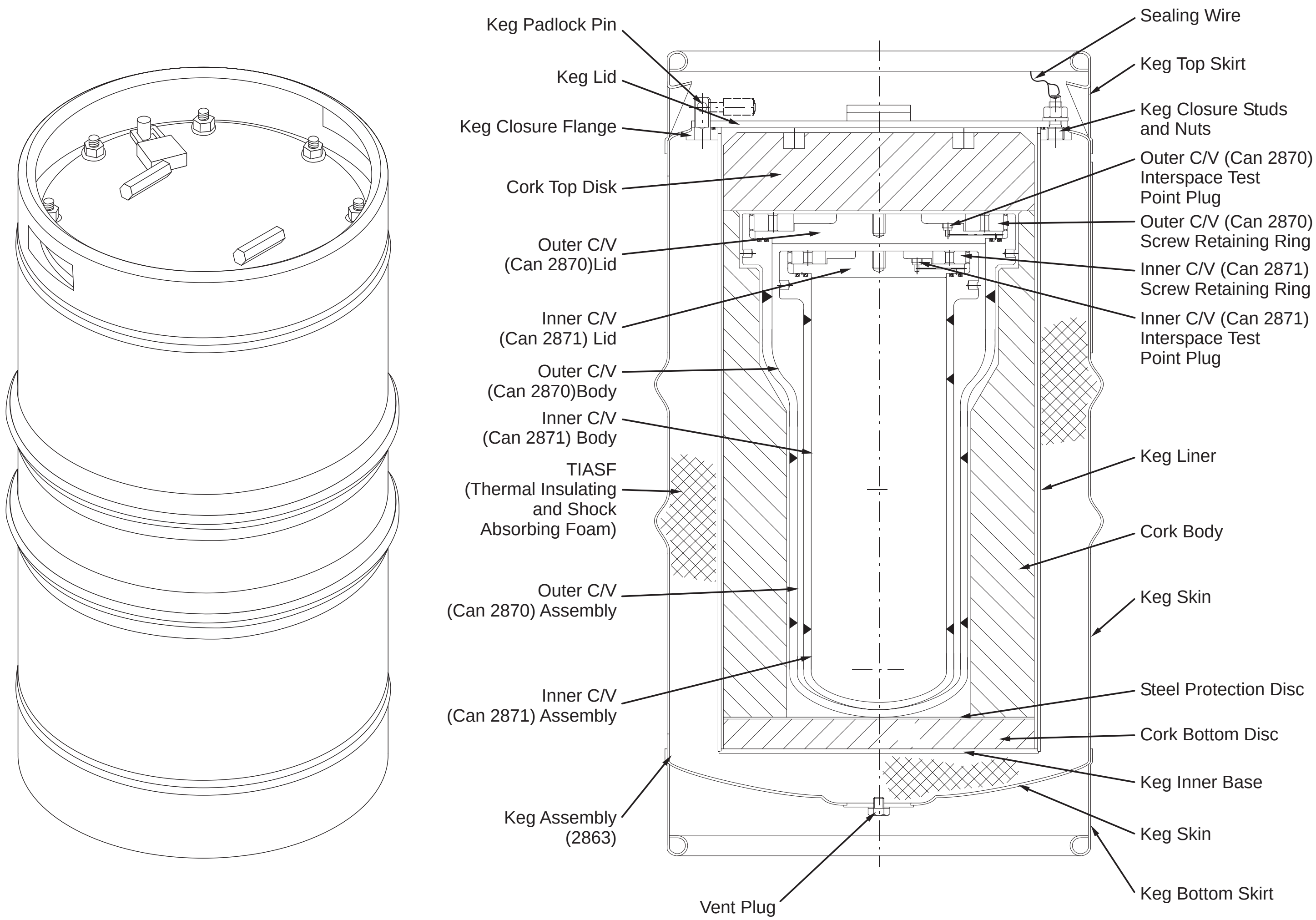
Most of the material currently stored at TA-18 can be accommodated within current and proposed DOE-owned packages or readily available commercial packages. DOE could choose to design new or use existing similar packaging. A select list of packages is described in detail to show the reader typical features of these packages. These packages have been used for the purpose of estimating input parameters, such as number of shipments and mass of contents, for the purpose of the impact analysis. Any new packages of similar designs could be used. Similar packaging would be designed to the same level of safety and would be expected to have similar features.

D.7.2.1 SAFKEG Packages

The SAFKEG 2863B packaging (see **Figure D–3**) consists of a CROFT keg model number 2863 (Keg 2863) which is 760 millimeters (30 inches) long and 425 millimeters (16.7 inches) diameter, and carries a double containment configuration using resealable containment vessels, model numbers 2870 and 2871 (Can 2870 and Can 2871). This packaging is to be used as a general purpose container for the shipment of solid or powder fissile or other actinide material. The contents have been limited such that the packaging does not require exclusive use provisions. The permitted internal heating of the contents is 30 watts. The allowable modes of transport are: road, rail, sea, and air (except that air shipment of plutonium is not allowed within the United States in this packaging). The package shall be externally labeled by the user in accordance with 49 CFR 172 subpart E. The SAFKEG 2863B package meets all applicable requirements of 10 CFR 71.

A SARP has been prepared to support a Certificate of Compliance for the SAFKEG 2863B shipping package (DOE 1999). Approval for use is requested in accordance with 49 CFR 173.7(d). The SARP addresses applicable NRC, DOE and the U.S. Department of Transportation rules and regulations regarding packaging and shipment of Type B radioactive material.

The packaging consists of an outer double skin insulated keg (Keg 2863), an insulating cork liner, an outer resealable containment vessel (Can 2870), and an inner resealable containment vessel (Can 2871). These resealable vessels are designed to remain within regulatory limits regarding leakage rate, under both normal and accident conditions of transport. The nominal weight of the packaging is 103.5 kilograms (228 pounds), excluding contents. The maximum contents weight is 20 kilograms (44 pounds). The keg and containment vessels along with the nomenclature used in the packaging description and analysis are provided in Figure D–2. The containment boundary for each containment vessel consists of the body, lid, and inner o-ring. The outer o-rings of the containment vessels and test port seals are not part of the containment boundary. The design pressure for the package is 8 bar absolute/116 pounds per square inch absolute



C/V = containment vessel.

Figure D–3 SAFKEG 2863B

(7 bar gauge/101.5 pounds per square inch gauge) which is the bounding pressure for the containment vessels for all environmental conditions.

The Keg 2863 consists of a double skinned stainless steel keg body. A flat stainless steel lid is secured with studs and nuts. The lid may be secured to prevent unauthorized removal by a padlock attached to a lockpin welded to the keg closure flange. Studs are provided for fitting tamper indicating devices in accordance with 10 CFR 71.43(b). The cavity between the double skin is filled with a thermal insulating and shock absorbing phenolic resin foam. This cavity is normally sealed but will vent through the vent plug at the bottom of the keg during a hypothetical accident fire. The assembled SAFKEG 2863B has an overall length of 760 millimeter (30 inches) and an overall diameter of 425 millimeter (16.7 inches). The keg is fitted with a nameplate that complies with the requirements in 10 CFR 71.85 and 49 CFR 173.444.

There is an insulating cork liner between the Keg 2863 and the outer containment vessel Can 2870. The top and bottom of this cork liner varies in thickness from 75 millimeters (3 inches) at the top to 28 millimeters (1.1 inches) at the base of the keg. The side-wall thickness of the cork liner varies from 14.5 millimeters (0.57 inches) at the top to 59.5 millimeters (2.3 inches) at the bottom.

The outer containment vessel (Can 2870) is made from stainless steel. The body is fabricated from four pieces, welded and tested. The seal between the body and the lid is effected by two, 3-millimeter (0.118-inch) chord diameter o-ring face seals; access to the interspace between the two o-rings is provided for operational and maintenance leak testing. The lid is held in position by a threaded retaining ring. Both the retaining ring and the lid are recessed into the body of the container, thus reducing the vulnerability of the closure.

The design, materials, and construction of the inner containment vessel (Can 2871) are similar to those of the outer containment vessel, but the inner containment vessel is smaller to enable it to fit inside the outer. The cavity has an overall length of 401 millimeters (15.75 inches) (to the bottom of the curved base) and a minimum diameter of 127.6 millimeters (5.024 inches). The vessel operates at atmospheric pressure, although the internal pressure may vary due to absorption of oxygen by the contents and heating of the gasses within the containment vessels by decay heat of the contents, by radiolysis of organic materials (when present) and atmospheric temperature and pressure.

D.7.2.2 DT-22 and D-23 Packages

DT-23 and DT-23 packages are functionally similar to the previously described SAFKEG, in that they rely on a steel drum and are supported by packing material to protect the hardened inner container. Each consists of an outer drum and an inner container made of Type 304 stainless steel, with Celotex fiber insulation between the drum and liner. The DT-22 outer structure is a 170-liter (45-gallon) drum about 64 centimeters (25 inches) in diameter and 71 centimeters (28 inches) in height. The inner container is made of 0.4-centimeter (0.16-inch) stainless steel and is about 32centimeters (12 inches) in diameter and 44 centimeters (17 inches) in height. The empty package weighs about 108 kilograms (238 pounds). The DT-23 outer structure is a 413-liter (109-gallon) drum about 84 centimeters (33 inches) in diameter and 104 centimeters (41 inches) in height. The inner container is made of 0.4-centimeter (0.16-inch) stainless steel and is about 53 centimeters (21 inches) in diameter and 69 centimeters (27 inches) in height. Both packages are double-containment packages that can be used to transport weapon parts, highly enriched uranium or plutonium. The empty package weighs about 246 kilograms (542 pounds).

D.7.2.3 Model FL Packages

FL 10-1 consists of two, 16-gauge 208-liter (55-gallon) drums welded end to end, approximately 172 centimeters (68 inches) long and 57 centimeters (22.5 inches) in diameter. The outer drum closure is accomplished by at least a 12-gauge bolt-locking ring with drop-forged lugs, one of which is threaded to receive at least a 1.6 centimeter (5/8-inch) diameter bolt and lock nut. The pressure vessel support mechanism consists of wood supports, steel inner sleeve and nut ring to receive the containment vessel, and fire resistant phenolic foam, formed in place. Gas relief holes are provided in the outer steel drum.

The containment vessel is a 304L stainless steel 12.7-centimeter (5-inch) Schedule 40 pipe, approximately 136 centimeters (53.5 inches) long, with a 304L stainless steel 1.3-centimeter (0.5-inch)-thick welded bottom plate and a 304L stainless steel slip-on flange and blind flange which is fastened by eight, 1.9-centimeter (0.75-inch) steel bolts. The flange closure is gasketed by two fluoroelastomer o-rings with a pressure tap between the two o-ring grooves. During shipment, the o-ring groove pressure tap is sealed with a pipe plug with threads wrapped in teflon tape. A steel valve is screwed into the blind flange of the containment vessel. The valve is sealed by a pipe cap (threads wrapped with Teflon tape) and is protected by a section of Schedule 40 pipe welded to the top of the flange. The packaging has a maximum gross weight of 234 kilograms (515 pounds).

The Model FL package is certified to carry a variety of fissile material solutions and dry compounds. The maximum quantities per package and the number of packages per shipment vary with the amount and form of the contents.

D.7.2.4 U.S. Department of Transportation 6M Packages

The original U.S. Department of Transportation 6M packaging (49 CFR 173.354) was Dow Chemical Corporation's Model 1518, a 38-liter (10-gallon) container, approved by the U.S. Atomic Energy Commission (now DOE) in March 1967 and issued as U.S. Department of Transportation Special Permit 5000 the following month. The 6M packaging was issued in December 1968 to cover a variety of similar containers ranging in capacity from 38 to 417 liters (10 to 110 gallons). The 6M packaging is currently authorized by U.S. Department of Transportation regulations for shipment of Type B quantities of radioactive materials (49 CFR 173, Subpart I).

In 1980, NRC expressed concern about shipping plutonium in the 6M packaging. Because of changing specifications, secondary containment for plutonium was required (10 CFR 71). NRC decided the 6M packaging was adequate as an overpack.

As secondary containment was required, NRC also wanted assurance that U.S. Department of Transportation Specification 2R (Inside Containment Vessel) would meet the new leak rates specified in the International Atomic Energy Agency regulations (Kelly 1994).

General construction requirements for the 6M packaging may be found in 49 CFR 178.354, *Specification 6M; Metal Packaging*, and for the 2R vessel in 49 CFR 178.360. Refer to **Figure D–4** for an example of a typical 6M package with the 2R inner vessel or container.

In response to U.S. Nuclear Regulatory Commission concerns, the DOE and its contractors expended considerable effort to determine what role the 6M packaging should have for shipping DOE-owned plutonium. Technical reviews and safety assessments have been performed on 6M specification packaging, 2R inner container welds associated with 6M packaging, the types and quantities of radioactive material being shipped in 6M packaging, and future packaging to replace the 6M. In 1988, a DOE task force

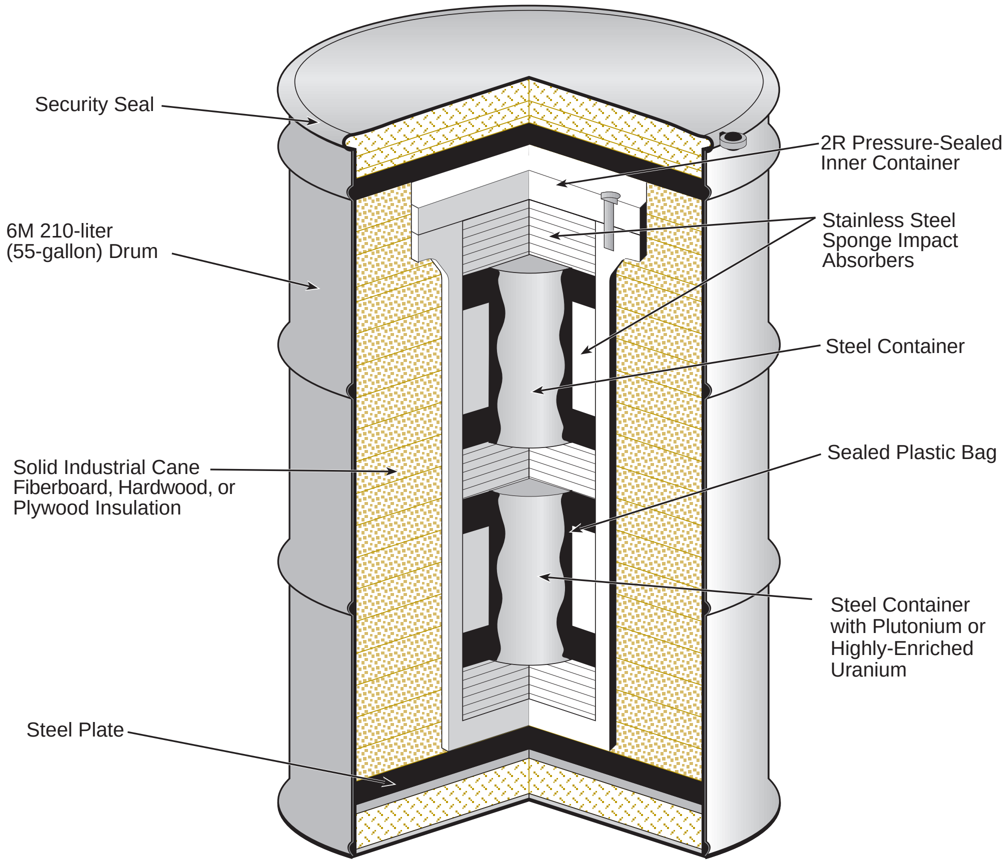


Figure D–4 Typical Assembly of 6M, Type B Packaging for Plutonium

performed a technical review of the 6M packaging configuration. The review and subsequent documentation found that the 6M packaging configuration merits continued use (SNL 1988).

The task force that studied this subject recognized that the use of the 6M is authorized by current U.S. Department of Transportation regulations and recommended procedural improvements for its continued use. It was determined that the number of product can configurations and the number of 6M drum sizes should be reduced, and that the major shipping sites should coordinate an effort to minimize the number of can configurations and drum sizes used for shipment of plutonium.

In 1988, weld defects were found in the DT-14A packages fabricated by a particular manufacturer. Because the manufacturer was a major supplier of 2R inner containers, the integrity of 2R inner containers became a concern. In 1989, DOE Headquarters issued directives (Wade 1989) to all Defense Programs Operations Offices that future shipments of Type B radioactive material in the 6M packaging implement the applicable requirements as specified in the DOE task force's technical document (SNL 1988). The Container Weld Advisory Committee was formed in 1989 to develop recommendations and provide criteria for specific weld issues related to the 2R inner container. The Container Weld Advisory Committee recommended static force testing to ensure that the weld was strong enough to withstand the postulated hypothetical accident condition loadings. Leak testing was specified to ensure that no leak paths existed in the weld. The safety enhancements developed will allow interim use of the 6M until a replacement container is available. As a result, 2R inner-containment vessels have had their bottom plate welds static force tested and leak tested.

The purpose of the added requirements is to allow interim use of the 6M configuration until a replacement container is available (Kelly 1994).

The outer shell of the 6M packaging is made of straight-sided steel, with welded body seams, and in accordance with U.S. Department of Transportation Specification 6C or 17C, with each length to contain 3 wedged or rolled rolling hoops as prescribed for either of these specifications. A removable head has one or more corrugations in the cover near the periphery. For a packaging exceeding 57 liters (15 gallons) volume, the head must be crowned (convex), not extending beyond the level of the chime, with a minimum convexity of 1 centimeter (3/8 inches).

Each drum has at least four 1.2-centimeter (0.5-inch) diameter vents near the top, each covered with a weatherproof tape or fusible plug, or equivalent device. A layer of porous refractory fiber may be placed behind the pressure-relief vent holes.

The closure device has means for the attachment of a tamper-proof lock wire and seal.

The inner containment vessel is fixed within the outer shell by solid centering media, with the sides of the inner vessel protected by at least 9.5 centimeters (3.75 inches) of insulation media, and the ends with at least the thickness as prescribed in 49 CFR 178.104-3(a)(1). The centering media is usually machined discs and rings made of solid industrial can fiberboard having a density of at least 0.24 grams per cubic centimeter (15 pounds per cubic foot) fitted such that the radial clearances between the fiberboard, inner vessel, and shell do not exceed 6 millimeters (.25 inches).

When necessary, shielding may be provided within the 2R containment vessel. Any radiation shielding material used must be placed within the inner containment vessel or must be protected in all directions by at least the thickness of the thermal insulating material.

The primary containment vessel is constructed to U.S. Department of Transportation Specification 2R (49 CFR 178.360). Each vessel is made of stainless steel, malleable iron, or brass, or other material having equivalent physical strength and fire resistance.

The closure device is a screw-type cap or plug. The number of threads per inch must not be less than U.S. standard pipe threads and must have sufficient length of thread to engage at lease five threads when securely tightened. Pipe threads are luted with an appropriate nonhardening compound which must be capable of withstanding up to 149 degrees celsius (300 degrees fahrenheit) without loss of efficiency. Tightening torque is adequate to maintain leak tightness with the specific luting compound.

D.7.3 Representative Routes

Representative truck routes were selected for the shipments from TA-18 to SNL/NM, NTS and ANL-W. The routes were selected consistent with current routing practices and all applicable routing regulations and guidelines. However, the routes were determined for risk assessment purposes. They do not necessarily represent the actual routes that would be used to transport radioactive materials in the future. Specific routes cannot be identified in advance. The representative truck routes are shown in **Figure D–5**.

Route characteristics that are important to the radiological risk assessment include the total shipment distance and the population distribution along the route. The specific route selected determines both the total potentially exposed population and the expected frequency of transportation-related accidents. Route characteristics are summarized in **Table D–1**. The population densities along each route are derived from 1990 U.S. Bureau of Census data. Rural, suburban, and urban areas are characterized according to the

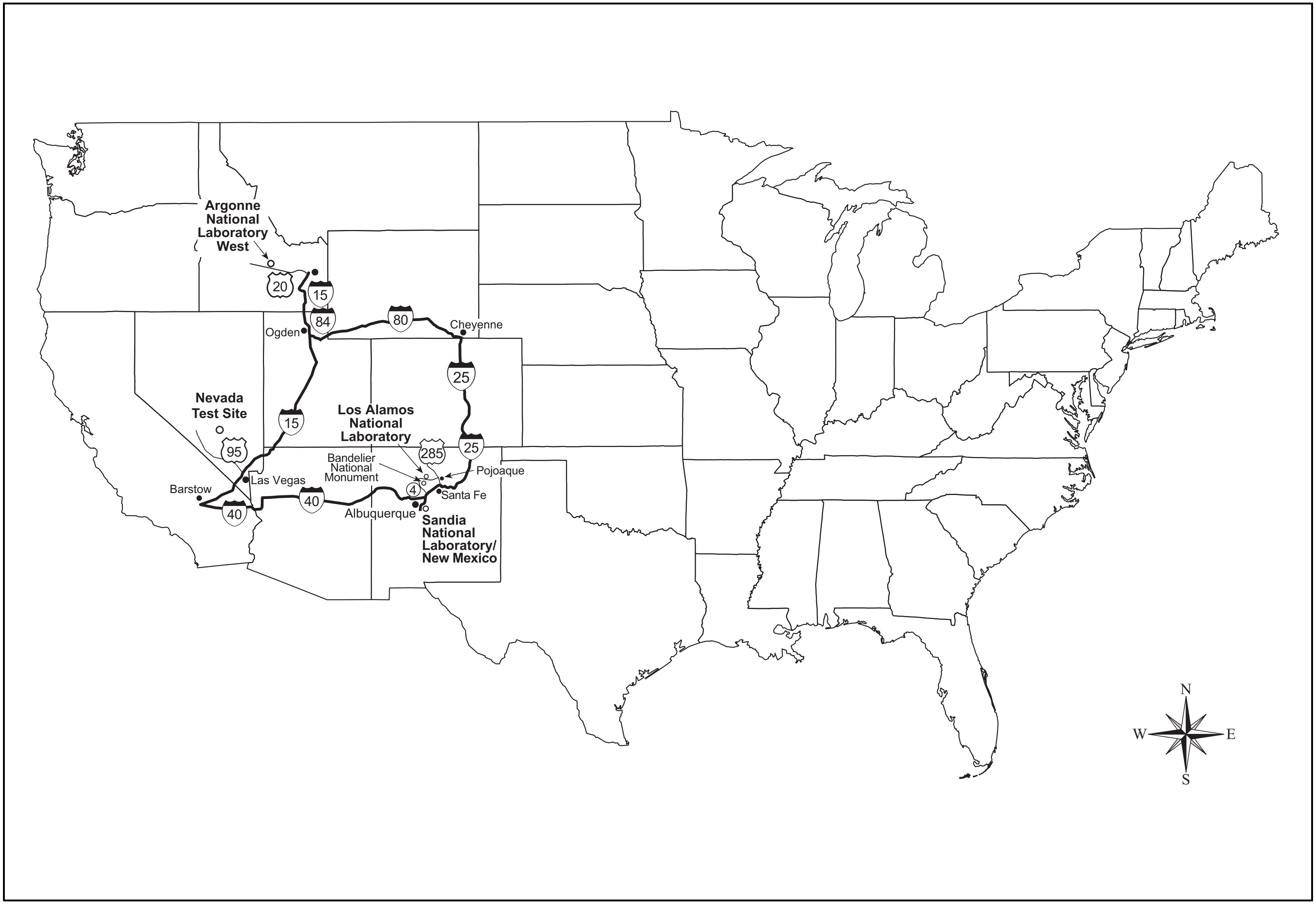


Figure D–5 Representative Overland Truck Route following breakdown: rural population densities range from 0 to 54 persons per square kilometer (0 to 139 persons per square mile); the suburban range is from 55 to 1,284 persons per square kilometer (140 to 3,326 persons per square mile); and the urban range includes all population densities greater than 1,284 persons per square kilometer (3,326 persons per square mile). The affected population, for route characterization and incident-free dose calculation, includes all persons living within 800 meters (0.5 mile) of each side of the road.

Table D–1 Potential Shipping Routes Evaluated for the TA-18 Relocation EIS

From	*To*	*Distance (kilometers)*	*Percentages in Zones*			*Population Density in Zone (per square kilometer)*			*Number of Affected Persons*
			Rural	*Suburban*	*Urban*	*Rural*	*Suburban*	*Urban*	
Truck Routes									
TA-18	NTS	1,671	93.4	5.9	0.7	3.6	381	2,096	108,000
TA-18	SNL/NM	167	78.9	16.1	5	8.6	431	2,125	49,000
TA-18	ANL-W	1,873	89.4	9.1	1.4	4.5	393	2,085	207,000

D.7.4 External Dose Rates

The external dose rates are conservatively estimated using engineering judgment. Based on DOE's operational experience, external dose rates from packages containing enriched uranium, plutonium, and thorium would generally be low. Therefore, for 82 of the 87 shipments of radioactive and SNM, the dose rate at 1 meter from the vehicle is estimated to be 1 millirem per hour. It is assumed that 5 of the 87 shipments would be carrying material, such as uranium-233, that has a much higher contact dose rate. For these shipments, a dose rate of 10 millirem per hour, at 1 meter from the vehicle, was assumed. This is just below the regulatory limit of 10 millirem per hour at 2 meters. Additionally, about 5 shipments are assumed to be needed to ship the machines and 10 metric tons of depleted and natural uranium and thorium (which do not require special security measures such as described in Section D.5). The average dose rate for the depleted and natural uranium and thorium shipments is estimated to be 0.1 millirem at 1 meter from the vehicle.

D.7.5 Health Risk Conversion Factors

The health risk conversion factors used to estimate expected cancer fatalities were: 0.0005 and 0.0004 latent cancer fatalities per person-rem for members of the public and workers, respectively (NCRP 1993).

D.7.6 Accident Frequencies

For the calculation of accident risks, vehicle accident and fatality rates are taken from data provided in ANL/ESD/TM-150 (Saricks and Tompkins 1999). Accident rates are generically defined as the number of accident involvements (or fatalities) in a given year per unit of travel in that same year. Therefore, the rate is a fractional value, with accident-involvement count as the numerator of the fraction and vehicular activity (total travel distance in truck-kilometers) as its denominator. Accident rates are generally determined for a multiyear period. For assessment purposes, the total number of expected accidents or fatalities is calculated by multiplying the total shipment distance for a specific case by the appropriate accident or fatality rate.

For truck transportation, the rates presented are specifically for heavy combination trucks involved in interstate commerce (Saricks and Tompkins 1999). Heavy combination trucks are rigs composed of a separable tractor unit containing the engine and one to three freight trailers connected to each other. Heavy combination trucks are typically used for radioactive material shipments. The truck accident rates are computed for each state based on statistics compiled by the Federal Highway Administration, Office of Motor Carriers from 1994 to 1996. A fatality caused by an accident is the death of a member of the public who is killed instantly or dies within 30 days due to the injuries sustained in the accident.

The HIGHWAY code classifies highways as rural, suburban or urban, and provides the distance and population information for use in RADTRAN. These codes require accident frequency data calculated for rural, urban and suburban zones. An older report, ANL/ESD/TM-68 (Saricks and Kvitek 1994), reports accident rates for Federally Aided Interstates in urban and rural areas, and a composite accident rate for all Federally Aided Interstates. TM-150 does not provide data that can be directly used to estimate frequencies for rural, urban and suburban zones. The ratios of accident frequencies for the zones was calculated from TM-68 data, and used with the newer TM-150 data to establish up-to-date accident frequency estimates. Since the distance traveled on non-interstate highways was very small compared to the distance traveled on interstates, and the accident rates are similar, interstate accident rates were used for all roads. TM-68 and TM-150 information is used for both the accident rate estimate for the radiological risk, and the fatal accident rate estimate for the nonradiological risk.

For SST/SGT transportation, the rates presented are specifically adjusted for the experience of the DOE Transportation Safeguards Division. Between fiscal year 1984 and fiscal year 1998, the Transportation Safeguards Division reports 0.058 accidents per million kilometers (0.096 accidents per million miles) (Claus and Shyr 1999). Using influence factors from SAND93-0111 (Phillips, Clauss, and Blower 1994), accident frequencies for rural, urban, and suburban driving can be estimated.

D.7.7 Container Accident Response Characteristics and Release Fractions

D.7.7.1 Development of Conditional Probabilities

NUREG-0170 (NRC 1977) originally was used to estimate the conditional probabilities associated with the accidents involving transportation of radioactive materials. The analysis was primarily performed using best engineering judgments and presumptions concerning cask response. Design parameters of the representative casks were chosen to meet the minimum test criteria specified in 10 CFR 71. The study is believed to provide realistic, yet conservative, results for radiological releases under transport accident conditions.

As discussed above, the accident consequence assessment only considers the potential impacts from the most severe transportation accidents. In terms of risk, the severity of an accident must be viewed in terms of potential radiological consequences, which are directly proportional to the fraction of the radioactive material within a cask that is released to the environment during the accident. Although regions span the entire range of mechanical and thermal accident loads, they are grouped into accident categories that can be characterized by a single set of release fractions and are, therefore, considered together in the accident consequence assessment. The accident category severity fraction is the sum of all conditional probabilities in that accident category.

D.7.7.2 Release Fraction Assumptions

The release fractions for each material form (metal, non-metallic solid, liquid, powder and gaseous) were taken from NUREG-0170 (NRC 1977) and the aerosol and respirable fractions were taken from the RADTRAN 5 User Guide (Neuhauser and Kanipe 2000). These accident analysis parameters are generally applicable to a variety of materials and are conservative.

D.7.8 Nonradiological Risk (Vehicle-Related)

Vehicle-related health risks resulting from incident-free transport may be associated with the generation of air pollutants by transport vehicles during shipment and are independent of the radioactive nature of the shipment. The health end-point assessed under incident-free transport conditions is the excess latent mortality due to inhalation of vehicle exhaust emissions. The risk factor for pollutant inhalation in terms of latent mortality is 1×10^{-7} mortality per kilometer (1.6×10^{-7} per mile) of truck travel in urban areas (Neuhauser and Kanipe 2000). The risk factors are based on regression analyses of the effects of sulfur dioxide and particulate releases from diesel exhaust on mortality rates. Excess latent mortalities are assumed to be equivalent to latent cancer fatalities. Vehicle-related risks from incident-free transportation (affecting the population in urban areas along the transportation route) are calculated for each case by multiplying the total distance traveled in urban areas by the appropriate risk factor. Similar data are not available for rural and suburban areas.

Risks are summed over the entire route and over all shipments for each case. This method has been used in several EISs to calculate risks from incident-free transport. Lack of information for rural and suburban areas is an obvious data gap, although the risk factor would presumably be lower than for urban areas because of lower total emissions from all sources and lower population densities in rural and suburban areas.

D.7.9 Packaging and Handling Doses

TA-18 materials would be placed into packages for onsite or offsite shipment. These packages would be loaded onto SST/SGT or commercial trailers, shipped to the receiving site at LANL, NTS, SNL/NM, or ANL-W, unpacked and placed into storage. DOE's estimate of the radiation doses likely to be received by personnel moving (which includes handling, packaging, loading, and unloading) radioactive materials from TA-18 as part of moving the materials to another location is based on a review of TA-18 operational doses. The major assumption for this analysis is that the dose received from removing TA-18 material from its storage location, setting up experiments, and returning the material to storage is essentially the same as the dose for moving the radioactive materials. Another assumption is that the dose rate for the material handled for experiments is representative of the dose rates of all the TA-18 material being moved.

Based on a review of the radiological exposure information, in about 250 working days of the year 2000, material handlers working at TA-18 received about 0.250 person-rem (LANL 2001). For the purposes of the analysis, it was estimated that the workers handled the equivalent of one package per day. Therefore, TA-18 personnel received about 0.001 person-rem (or 1 person-millirem) for each package handled.

To estimate the potential handling dose to site workers at both the origin and the destination, this EIS assumed an average of 1 person-millirem per package would be handled. The number of packages to be placed in one shipment (a full SST/SGT or a commercial trailer) would be less than 25 per shipment. For the purpose of bounding the impacts, 25 packages in each of the 92 shipments was assumed. Multiplying these numbers equals 2,300 packages, which can be multiplied by the estimated dose to calculate 2.3 person-rem for the entire operation. Using the same approach, and assuming 20 packages would be required to move the material for SHEBA, estimates 0.02 person-rem for moving SHEBA material. Under the TA-18 Upgrade Alternative, there would be some movement of material to support modifications. The dose would be smaller than the dose received during normal operations and is estimated to be, at most, 0.250 person-rem, i.e., a dose equal to that associated with a year of material handling at TA-18.

D.8 RISK ANALYSIS RESULTS

Per-shipment risk factors have been calculated for the collective populations of exposed persons and for the crew for all anticipated routes and shipment configurations. The radiological risks are presented in doses per shipment for each unique route, material, and container combination. The radiological dose per shipment factors for incident-free transportation are presented in **Table D–2** for the transportation routes analyzed for this EIS.

Doses are calculated for the crew, off-link public (i.e., people living along the route), on-link public (i.e., pedestrians and drivers along the route), and public at rest and fueling stops (i.e., stopped cars, buses and trucks, workers, and other bystanders). For the onsite shipments (LANL Alternatives) quantitative impact analysis is not necessary. Since the shipments would be over a short distance, on closed DOE-controlled roads, LANL procedures ensure public safety. No incident free analysis is necessary because the public is not close enough to the vehicles to received measurable exposure. Worker dose is included in the process and handling dose estimates because the same personnel would be moving the radioactive and special nuclear material. No accident analysis is necessary because potential accidents during movement are bounded in frequency and consequence by handling accidents. Once the package is closed for the low-speed movement to the nearby building, the likelihood and consequence of any foreseeable accident are very small and not further quantified.

The radiological dose risk factors for transportation accidents are also presented in Table D–2. The accident risk factors are called "dose risk" because the values incorporate the spectrum of accident severity probabilities and associated consequences. The accident dose is very low because, although persons are residing in an 80 kilometers (50 miles) radius of the road, they are generally quite far from the road. Since RADTRAN 5 uses an assumption of homogeneous population from the road out to 80 kilometers (50 miles), it would greatly overestimate the actual doses. The accident analysis was performed using average equivalent plutonium-239 loading per shipment for both high- and low-contact dose materials.

The nonradiological risk factors are presented in fatalities per shipment in **Table D–3**. Separate risk factors are provided for fatalities resulting from exhaust emissions (caused by hydrocarbon emissions known to be carcinogens) and transportation accidents (fatalities resulting from impact).

Table D–4 shows the risks of transportation for each alternative. The risks are calculated by multiplying the previously given per-shipment factors by the number of shipments over the duration of the program and, for the radiological doses, by the health risk conversion factors.

The risks to various exposed individuals under incident-free transportation conditions have been estimated for hypothetical exposure scenarios. The estimated doses to workers and the public are presented in **Table D–5.**

All doses are presented on a per-event basis (person-rem per event) because it is not likely that the same person will be exposed to multiple events. The maximum dose to a crew member is based on the same individual being responsible for driving every shipment for the duration of the campaign. Note that the potential exists for larger individual exposures if multiple exposure events occur. For example, the dose to a person stuck in traffic next to a shipment for 10 minutes is calculated to be 0.03 millirem. However, since the intersite shipments pass through urban areas, a 30-minute exposure time is considered. Using the estimated dose rates, the maximally exposed individual would receive 0.1 millirem.

Table D–2 Radiological Risk Factors for Single Shipments

From TA-18 To	Material	Incident-Free Dose (person-rem)					Accident Dose (person-rem)
			Public				
		Crew	Off-Link	On-Link	Stops	Total	
NTS	Low-contact dose	0.00042	0.000032	0.00035	0.00018	0.00056	3.3×10^{-7}
	High-contact dose	0.042	0.0032	0.035	0.018	0.056	
	Uranium and thorium	0.000042	3.2×10^{-6}	0.000035	0.000064	0.00010	$<1.0 \times 10^{-10}$
SNL/NM	Low-contact dose	0.000042	9.5×10^{-6}	0.000041	1.8×10^{-5}	0.000068	8.2×10^{-8}
	High-contact dose	0.0042	0.0010	0.0041	0.0018	0.0068	
	Uranium and thorium	4.2×10^{-6}	9.5×10^{-7}	4.1×10^{-6}	6.5×10^{-6}	0.000012	$<1.0 \times 10^{-10}$
ANL-W	Low-contact dose	0.00047	0.000055	0.00041	0.00020	0.00066	4.3×10^{-7}
	High-contact dose	0.047	0.0055	0.041	0.020	0.066	
	Uranium and thorium	0.000047	5.5×10^{-6}	0.000041	0.00012	0.00012	$<1.0 \times 10^{-10}$

Table D–3 Nonradiological Risk Factors per Shipment

Nonradiological Risk Estimates (fatalities/shipment)				
	Exhaust Emission		Accident	
From TA-18 To	Truck	SST	Truck	SST
NTS	2.3×10^{-6}	3.0×10^{-6}	1.7×10^{-6}	2.6×10^{-7}
SNL/NM	1.7×10^{-6}	2.2×10^{-6}	4.7×10^{-7}	7.1×10^{-8}
ANL-W	5.2×10^{-6}	6.8×10^{-6}	2.9×10^{-6}	4.5×10^{-7}

Table D–4 Risks of Transporting the Hazardous Materials[a]

			Incident-Free				*Accident*	
			Radiological			*Nonradiological*		
Alternative	***Number of Shipments***	***Distance on Public Roads (kilometers)***	***Vehicle Crew***	***Packaging and Handling***	***Public***	***Emission***	***Traffic***	***Radiological***
No Action	(b)							
TA-18 Upgrade	(b)			0.0001				
LANL New Facility	(c)	less than 1,000		0.0009				
NTS	92	307,000	0.00010	0.0009	0.00016	0.00028	0.000031	1.4×10^{-8}
SNL/NM	92	31,000	0.000010	0.0009	0.00020	0.00020	8.5×10^{-6}	3.5×10^{-9}
ANL-W	92	345,000	0.00011	0.0009	0.00019	0.00062	0.000054	1.9×10^{-8}

[a] All risks are expressed as number of latent cancer fatalities, except for the Accident-Traffic column, which lists number of accident fatalities.
[b] Very little onsite and no offsite transportation for the No Action and TA-18 Upgrade Alternatives, therefore no accident or public risk analysis was performed.
[c] Probably more shipments than other alternatives, but not evaluated because population, distance, and accident risk would be smaller than other alternatives. The shipments would be on site at LANL, therefore, no accident or public risk analysis was performed.

Table D–5 Estimated Dose to Exposed Individuals During Incident-Free Transportation Conditions

Receptor		***Dose to Maximally Exposed Individual***
Workers	Crew member (truck driver) [a]	0.137 rem per year
	Inspector	0.000029 rem per event [b]
Public	Resident	4.0×10^{-9} rem per shipment
	Person in traffic congestion	0.00011 rem per event [b]

[a] Assumes that an individual driver takes every shipment.
[b] Event for an inspector means during inspection period, and for a person in traffic means during a 30-minute traffic jam.

The cumulative dose to a resident was calculated assuming all shipments passed his or her home. The cumulative doses assume that the resident is present for every shipment and is unshielded at a distance of 30 meters (about 98 feet) from the route. Therefore, the cumulative dose depends on the number of shipments passing a particular point and is independent of the actual route being considered. The maximum dose to this resident, if all the material were to be shipped via this route, would be less than 0.01 millirem.

The estimated dose to transportation crew members is presented for a commercial crew. No credit is taken for the shielding associated with the tractor or trailer.

The previously described accident risk assessment and the impacts provided in Table D–4 take into account the entire spectrum of potential accidents, from the fender-bender to extremely severe. To provide additional insight into the severity of accidents in terms of the potential dose to a maximally exposed individual, an accident consequence assessment has been performed for a hypothetical accident scenario. This accident would fall into Severity Category 8 of the NUREG-0170 accident matrix (NRC 1977), which is the only category with a release of radioactive material. To incur this level of damage, the vehicle would have to collide with an immovable object at a speed much greater than 88 kilometers per hour (55 miles per hour), and the contents of the vehicle would have to end up in a sustained fire. This analysis was performed irrespective of its potential likelihood. The maximally exposed individual was assumed to be 33 meters (108 feet) directly downwind of the accident and to remain at that location for 40 minutes. The accident could result in a dose of 139 rem to the maximally exposed individual.

D.9 LONG-TERM IMPACTS OF TRANSPORTATION

The Programmatic Spent Nuclear Fuel EIS (DOE 1995) analyzed the cumulative impacts of all transportation of radioactive materials, including impacts from reasonably foreseeable actions that include transportation of radioactive material for a specific purpose and general radioactive materials transportation that is not related to a particular action. The total worker and general population collective doses are summarized in **Table D–6**. The table shows that the impacts of this program are quite small compared with overall transportation impacts. Total collective worker dose from all types of shipments (historical, the alternatives, reasonably foreseeable actions, and general transportation) was estimated to be 320,000 person-rem (130 latent cancer fatalities) for the period 1943 through 2035 (93 years). Total general population collective dose was also estimated to be 320,000 person-rem (160 latent cancer fatalities). The majority of the collective dose for workers and the general population was due to the general transportation of radioactive material. Examples of these activities are shipments of radiopharmaceuticals to nuclear medicine laboratories and shipments of commercial low-level radioactive waste to commercial disposal facilities. The total number of latent cancer fatalities estimated to result from radioactive materials transportation over the period between 1943 and 2035 was 290. Over this same period (93 years), approximately 28 million people would die from cancer, based on 300,000 cancer fatalities per year. It should be noted that the estimated number of transportation-related latent cancer fatalities would be indistinguishable from other latent cancer fatalities, and the transportation-related latent cancer fatalities are 0.0010 percent of the total number of latent cancer fatalities.

D.10 UNCERTAINTY AND CONSERVATISM IN ESTIMATED IMPACTS

The sequence of analyses performed to generate the estimates of radiological risk for transportation includes: (1) determination of the inventory and characteristics, (2) estimation of shipment requirements, (3) determination of route characteristics, (4) calculation of radiation doses to exposed individuals (including estimating of environmental transport and uptake of radionuclides), and (5) estimation of health effects. Uncertainties are associated with each of these steps. Uncertainties exist in the way that the physical systems being analyzed are represented by the computational models; in the data required to exercise the models (due to measurement errors, sampling errors, natural variability, or unknowns simply caused by the future nature of the actions being analyzed); and in the calculations themselves (e.g., approximate algorithms used by the computers).

Table D–6 Cumulative Transportation-Related Radiological Collective Doses and Latent Cancer Fatalities (1943 to 2035)

Category	*Collective Worker Dose (person-rem)*	*Collective General Population Dose (person-rem)*
TA-18 relocation transportation impacts (from Table D–5)	less than 1	less than 1
Other Nuclear Material Shipments		
Truck	11,000	50,000
Rail	820	1,700
General transportation (1943–2035)	310,000	270,000
Total collective dose	322,000	322,000
Total latent cancer fatalities	130	160

Source: DOE 1995.

In principle, one can estimate the uncertainty associated with each input or computational source and predict the resultant uncertainty in each set of calculations. Thus, one can propagate the uncertainties from one set of calculations to the next and estimate the uncertainty in the final, or absolute, result; however, conducting such a full-scale quantitative uncertainty analysis is often impractical and sometimes impossible, especially for actions to be initiated at an unspecified time in the future. Instead, the risk analysis is designed to ensure, through uniform and judicious selection of scenarios, models, and input parameters, that relative comparisons of risk among the various alternatives are meaningful. In the transportation risk assessment, this design is accomplished by uniformly applying common input parameters and assumptions to each alternative. Therefore, although considerable uncertainty is inherent in the absolute magnitude of the transportation risk for each alternative, much less uncertainty is associated with the relative differences among the alternatives in a given measure of risk.

In the following sections, areas of uncertainty are discussed for the assessment steps enumerated above. Special emphasis is placed on identifying whether the uncertainties affect relative or absolute measures of risk. The reality and conservatism of the assumptions are addressed. Where practical, the parameters that most significantly affect the risk assessment results are identified.

D.10.1 Uncertainties in Material Inventory and Characterization

The inventories and the physical and radiological characteristics are important input parameters to the transportation risk assessment. The potential amount of transportation for any alternative is determined primarily by the projected dimensions of package contents, the strength of the radiation field, the heat that must be dissipated, and assumptions concerning shipment capacities. The physical and radiological characteristics are important in determining the material released during accidents and the subsequent doses to exposed individuals through multiple environmental exposure pathways.

Uncertainties in the inventory and characterization are reflected in the transportation risk results. If the inventory is overestimated (or underestimated), the resulting transportation risk estimates are also overestimated (or underestimated) by roughly the same factor. However, the same inventory estimates are used to analyze the transportation impacts of each of the EIS alternatives. Therefore, for comparative purposes, the observed differences in transportation risks among the alternatives, as given in Table D–4, are believed to represent unbiased, reasonably accurate estimates from current information in terms of relative risk comparisons.

D.10.2 Uncertainties in Containers, Shipment Capacities, and Number of Shipments

The transportation required for each alternative is based in part on assumptions concerning the packaging characteristics and shipment capacities for commercial trucks. Representative shipment capacities have been defined for assessment purposes based on probable future shipment capacities. In reality, the actual shipment capacities may differ from the predicted capacities such that the projected number of shipments and, consequently, the total transportation risk would change. However, although the predicted transportation risks would increase or decrease accordingly, the relative differences in risks among alternatives would remain about the same.

D.10.3 Uncertainties in Route Determination

Representative routes have been determined between all origin and destination sites considered in the EIS. The routes have been determined to be consistent with current guidelines, regulations, and practices, but may not be the actual routes that would be used in the future. In reality, the actual routes could differ from the representative ones with regard to distances and total population along the routes. Moreover, since materials could be transported over an extended time starting at some time in the future, the highway infrastructures and the demographics along routes could change. These effects have not been accounted for in the transportation assessment; however, it is not anticipated that these changes would significantly affect relative comparisons of risk among the alternatives considered in the EIS. Specific routes cannot be identified in advance because the routes are classified to protect national security interests.

D.10.4 Uncertainties in the Calculation of Radiation Doses

The models used to calculate radiation doses from transportation activities introduce a further uncertainty in the risk assessment process. Estimating the accuracy or absolute uncertainty of the risk assessment results is generally difficult. The accuracy of the calculated results is closely related to the limitations of the computational models and to the uncertainties in each of the input parameters that the model requires. The single greatest limitation facing users of RADTRAN, or any computer code of this type, is the scarcity of data for certain input parameters.

Uncertainties associated with the computational models are reduced by using state-of-the-art computer codes that have undergone extensive review. Because many uncertainties are recognized but difficult to quantify, assumptions are made at each step of the risk assessment process intended to produce conservative results (i.e., overestimate the calculated dose and radiological risk). Because parameters and assumptions are applied consistently to all alternatives, this model bias is not expected to affect the meaningfulness of relative comparisons of risk; however, the results may not represent risks in an absolute sense.

Post accident mitigative actions are not considered for dispersal accidents. For severe accidents involving the release and dispersal of radioactive materials in the environment, no post accident mitigative actions, such as interdiction of crops or evacuation of the accident vicinity, have been considered in this risk assessment. In reality, mitigative actions would take place following an accident according to U.S. Environmental Protection Agency radiation protection guides for nuclear incidents (EPA 1992). The effects of mitigative actions on population accident doses are highly dependent upon the severity, location, and timing of the accident. For this risk assessment, ingestion doses are only calculated for accidents occurring in rural areas (the calculated ingestion doses, however, assume all food grown on contaminated ground is consumed and is not limited to the rural population). Examination of the severe accident consequence assessment results has shown that ingestion of contaminated foodstuffs contributes about 50 percent of the total population dose for rural accidents. Interdiction of foodstuffs would act to reduce, but not eliminate, this contribution.

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APPENDIX E

Environmental Justice

TA-18

APPENDIX E
ENVIRONMENTAL JUSTICE

E.1 INTRODUCTION

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 FR 7629), directs Federal agencies to identify and address, as appropriate, disproportionately high and adverse health or environmental effects of their programs, policies, and activities on minority populations and low-income populations.

The Council on Environmental Quality (CEQ) has oversight responsibility for documentation prepared in compliance with the National Environmental Policy Act (NEPA). In December 1997, the Council released its guidance on environmental justice under NEPA (CEQ 1997). The Council's guidance was adopted as the basis for the analysis of environmental justice contained in this *Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory (TA-18 Relocation EIS)*.

This appendix provides an assessment of the potential for disproportionately high and adverse human health or environmental effects on minority and low-income populations resulting from the implementation of the alternatives described in Chapter 3 of the *TA-18 Relocation EIS*. The *TA-18 Relocation EIS* was prepared during a time when the U.S. Bureau of the Census is analyzing and publishing results of the decennial census conducted in 2000 (hereafter referred to as Census 2000). As discussed below, Census 2000 data were included in this analysis based on availability at the time of publication. Results and projections from the 1990 Census were used to fill gaps in available demographic data.

E.2 DEFINITIONS

Minority Individuals and Populations

The following definitions of minority individuals and population were used in this analysis of environmental justice:

- **Minority individuals—**Individuals who are members of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races. This definition is similar to that given in the CEQ environmental justice guidance (CEQ 1997), except that it has been modified to reflect *Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity* (62 FR 58782) and recent guidance (OMB 2000) published by the Office of Budget and Management. These revisions were adopted and used by the Bureau of the Census in collecting data for Census 2000. When data from the 1990 Census are used, a minority individual will be defined as someone self-identified as: Hispanic; American Indian, Eskimo, or Aleut; Asian or Pacific Islander; or Black. As discussed below, racial and ethnic data from the 1990 Census cannot be directly compared with that from Census 2000.

  The Office of Management and Budget has also recommended that persons self-identified as multiracial should be counted as a minority individual if one of the races is a minority race (OMB 2000). During Census 2000, approximately 2 percent of the population identified themselves as members of more than one race (DOC 2001). Approximately two-thirds of those designated themselves as members of at least one minority race. For the purposes of evaluation in this environmental impact statement (EIS), where more detailed data is not available, persons designating themselves as members of more than one race were included in the minority population. This will tend to overestimate the minority population, but the uncertainties are small and would not affect the conclusions regarding environmental justice.

- **Minority population—**Minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. In identifying minority communities, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a geographically dispersed and transient set of individuals (such as migrant workers or American Indians/Alaska Natives), where either type of group experiences common conditions of environmental exposure or effect. The selection of the appropriate unit of geographic analysis may be a governing body's jurisdiction, a neighborhood, census tract, or other similar unit that is to be chosen so as to not artificially dilute or inflate the affected minority population. A minority population also exists if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds.

In the discussions of environmental justice in this EIS, persons self-designated as Hispanic or Latino are included in the Hispanic or Latino population, regardless of race. For example, the Asian population is composed of persons self-designated as Asian and not of Hispanic or Latino origin. Asians who designated themselves as having Hispanic or Latino origins are included in the Hispanic or Latino population. Data for the analysis of minority populations in 1990 were extracted from Table P012 of Summary Tape File 3 (DOC 1992). Census 2000 data were obtained from the Census Bureau's website at address www.census.gov.

Low-Income Populations and Individuals

Executive Order 12898 specifically addresses "disproportionately high and adverse effects" on "low-income" populations. The CEQ recommends that poverty thresholds be used to identify "low-income" individuals (CEQ 1997).

The following definition of low-income population was used in this analysis:

- **Low-income population—**Low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the U.S. Bureau of the Census' *Current Population Reports, Series P–60 on Income and Poverty*. In identifying low-income populations, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or American Indians/Alaska Natives), where either type of group experiences common conditions of environmental exposure or effect (CEQ 1997).

Data for the analysis of low-income populations were extracted from Table P121 of Summary Tape File 3 (DOC 1992). Detailed income data resulting from Census 2000 is not yet available. It will be incorporated into the *Final TA-18 Relocation EIS* if it becomes available prior to publication of the Final EIS.

Disproportionately High and Adverse Human Health Effects

Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal adverse impacts to human health. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority population or low-income population is significant and exceeds the risk of exposure rate for the general population or for another appropriate comparison group (CEQ 1997).

Disproportionately High and Adverse Human Environmental Effects

A disproportionately high environmental impact refers to an impact or risk of an impact in a low-income or minority community that is significant and exceeds the environmental impact on the larger community. An adverse environmental impact is an impact that is determined to be both harmful and significant. In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed or minority low-income populations are considered (CEQ 1997).

Potentially affected areas examined in this EIS include areas defined by an 80-kilometer (50-mile) radius centered on candidate facilities for TA-18 activities. As discussed in Chapter 3, candidate sites include Los Alamos National Laboratory (LANL), Sandia National Laboratories/New Mexico (SNL/NM), Nevada Test Site (NTS), and Argonne National Laboratory-West (ANL-W) at the Idaho National Engineering and Environmental Laboratory. Potentially affected areas used in the analysis of environmental justice are the same as those used in the analysis of radiological health effects described in Chapter 5.

E.3 METHODOLOGY

E.3.1 Spatial Resolution

For the purposes of enumeration and analysis, the Census Bureau has defined a variety of areal units (DOC 1992). Areal units of concern in this document include (in order of increasing spatial resolution) states, counties, census tracts, block groups, and blocks. The "block" is the smallest of these entities and offers the finest spatial resolution. This term refers to a relatively small geographical area bounded on all sides by visible features such as streets and streams or by invisible boundaries such as city limits and property lines. During the 1990 census, the Census Bureau subdivided the United States and its territories into 7,017,425 blocks. For comparison, the number of counties, census tracts, and block groups used in the 1990 census were 3,248; 62,276; and 229,192; respectively. While blocks offer the finest spatial resolution, economic data required for the identification of low-income populations are not available at the block-level of spatial resolution. In the analysis below, block groups are used throughout as the areal unit. Block groups generally contain between 250 and 500 housing units (DOC 1992).

During the decennial census, the Census Bureau collects data from individuals and aggregates the data according to residence in a geographical area, such as a county or block group. This EIS uses data from the 1990 census as a baseline for calculations performed with block group level spatial resolution. The Census Bureau has not yet published block group level results of the 2000 census. The data are scheduled for publication in mid-2002.

Boundaries of the areal units are selected to coincide with features such as streams and roads or political boundaries such as county and city borders. Boundaries used for aggregation of the census data usually do not coincide with boundaries used in the calculation of health effects. As discussed in Chapter 5, radiological health effects due to an accident at each of the sites considered for the proposed actions are evaluated for persons residing within a distance of 80 kilometers (50 miles) of an accident site. In general, the boundary of the circle with an 80-kilometer (50-mile) radius centered at the accident site will not coincide with boundaries used by the Census Bureau for enumeration of the population in the potentially affected area. Some block groups lie completely inside or outside of the radius for health effects calculation. However, other block groups are only partially included. As a result of these partial inclusions, uncertainties are introduced into the estimate of the population at risk from the accident.

To estimate the populations at risk in partially included block groups, it was assumed that populations are uniformly distributed throughout the area of each block group. For example, if 30 percent of the area of a block group lies within 80 kilometers (50 miles) of the accident site, it was assumed that 30 percent of the population residing in that block group would be at risk.

E.3.2 Population Projections

Health effects were calculated for populations projected to reside in potentially affected areas during the year 2001. Extrapolations of the total population for individual states are available from both the Census Bureau and various state agencies (Campbell 1996). The Census Bureau also projects populations by ethnic and racial classification in one-year intervals for the years from 1995 to 2025 at the state level (Campbell 1997). State agencies project total populations for individual counties. No Federal or state agency projects block group or low-income populations. Data used to project minority populations were extracted from the Census Bureau's World Wide Web site at address www.census.gov. To project minority populations in potentially affected areas, minority populations determined from the 1990 census data were taken as a baseline for each block group. Then it was assumed that percentage changes in the minority population of each block group for a given year (compared to the 1990 baseline data) will be the same as percentage changes in the state minority population projected for the same year. An advantage to this assumption is that the projected populations are obtained using a consistent method, regardless of the state and associated block group involved in the calculation. A disadvantage is that the method is insensitive to localized demographic changes that could alter the projection in a specific area.

The Census Bureau uses the cohort-component method to estimate future populations for each state (Campbell 1996). The set of cohorts is comprised of: (1) age groups from one year or less to 85 years or more, (2) male and female populations in each age group, and (3) the following racial and ethnic groups in each age group: Hispanic, non-Hispanic Asian, non-Hispanic Black, non-Hispanic Native American, and non-Hispanic White. Racial and ethnic groups will change in the projections based on Census 2000 data. Components of the population change used in the demographic accounting system are births, deaths, net state-to-state migration, and net international migration. If P(t) denotes the number of individuals in a given cohort at time "t," then:

$$P(t) = P(t_0) + B - D + DIM - DOM + IIM - IOM$$

where:

$P(t_0)$	=	Cohort population at time $t_0 \leq t$. For this analysis, t_0 denotes the year 1990.
B	=	Births expected during the period from t_0 to t.
D	=	Deaths expected during the period from t_0 to t.
DIM	=	Domestic migration into the state expected during the period from t_0 to t.
DOM	=	Domestic migration out of the state expected during the period from t_0 to t.
IIM	=	International migration into the state expected during the period from t_0 to t.
IOM	=	International migration out of the state expected during the period from t_0 to t.

Estimated values for the components shown on the right side of the equation are based on past data and various assumptions regarding changes in the rates for birth, mortality, and migration (Campbell 1996). It should be noted that the Census Bureau does not project populations of individuals who identified themselves as "other race" during the 1990 census. This population group is less than 2 percent of the total population in each of the states. However, to project total populations in the environmental justice analysis, population projections for the "other race" group were made under the assumption that the growth rate for the "other race" population will be identical to the growth rate for the combined minority and white populations.

E.4 ENVIRONMENTAL JUSTICE ANALYSIS

The analysis of environmental justice concerns was based on an assessment of the impacts reported in Chapter 5. This analysis was performed to identify any disproportionately high and adverse human health or environmental impacts on minority or low-income populations surrounding the candidate sites. Demographic information obtained from the Census Bureau was used to identify the minority populations and low-income communities in the zone of potential impact surrounding the sites (DOC 1992 and www.census.gov). Data from Census 2000 were used to identify minority populations at risk in potentially affected counties. Census 1990 data projected to the year 2001 were used for detailed calculations.

E.5 RESULTS FOR THE CANDIDATE SITES

E.5.1 Los Alamos National Laboratory (LANL)

As discussed in Chapter 3, three technical areas at LANL are associated with the relocation of TA-18 mission activities (see **Figure E–1**): 1) TA-18, the current location, 2) TA-55, candidate for relocation of TA-18 mission activities except SHEBA activities, and 3) TA-39, candidate for relocation of SHEBA activities.

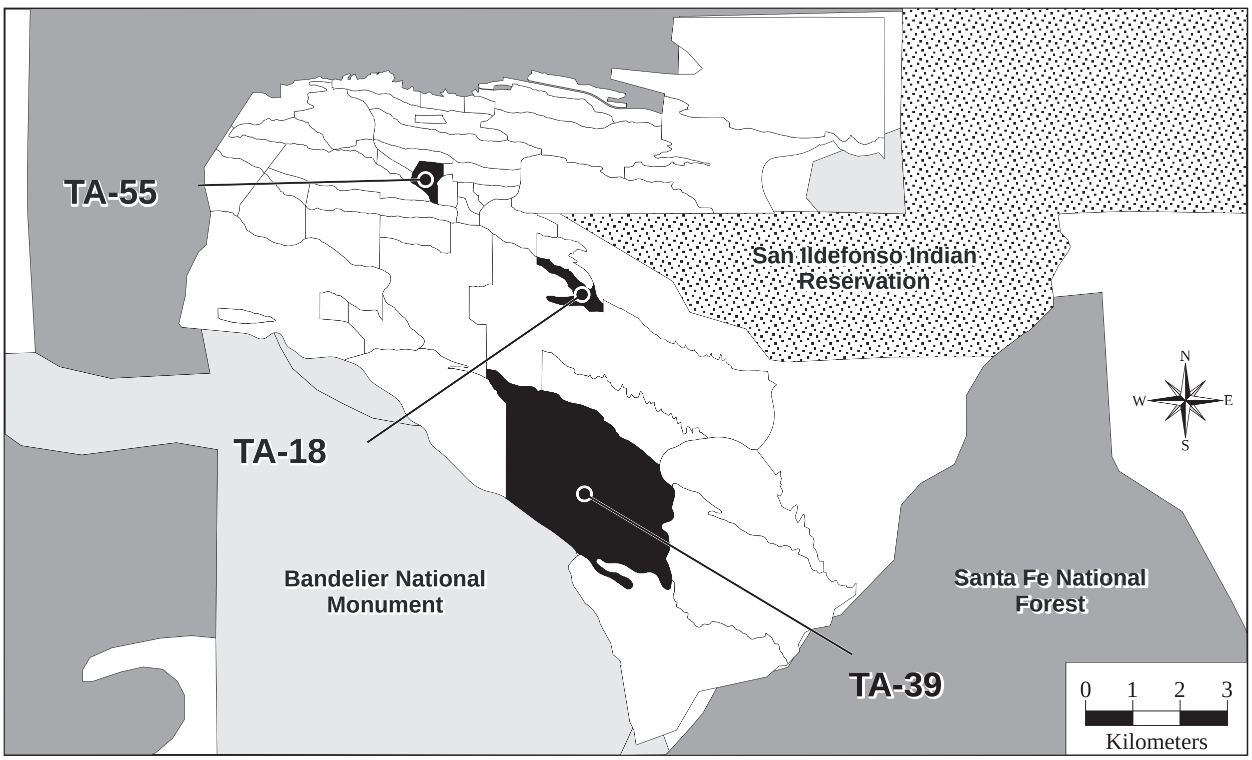

Figure E–1 Candidate Technical Areas at LANL

Figure E–2 and **Table E–1** show the counties at radiological risk and the composition of the population of these counties, respectively. The Counties are: Bernalillo, Los Alamos, Mora, Rio Arriba, Sandoval, San Miguel, Santa Fe, and Taos. As indicated in Figure E–2, circles of 80 kilometers (50 miles) radius centered at the three candidate technical areas all contain or intersect the same nine counties. The total population at risk from the SHEBA mission at TA-39 would be the largest of the three populations at risk because TA-39 is closest to Bernalillo County.

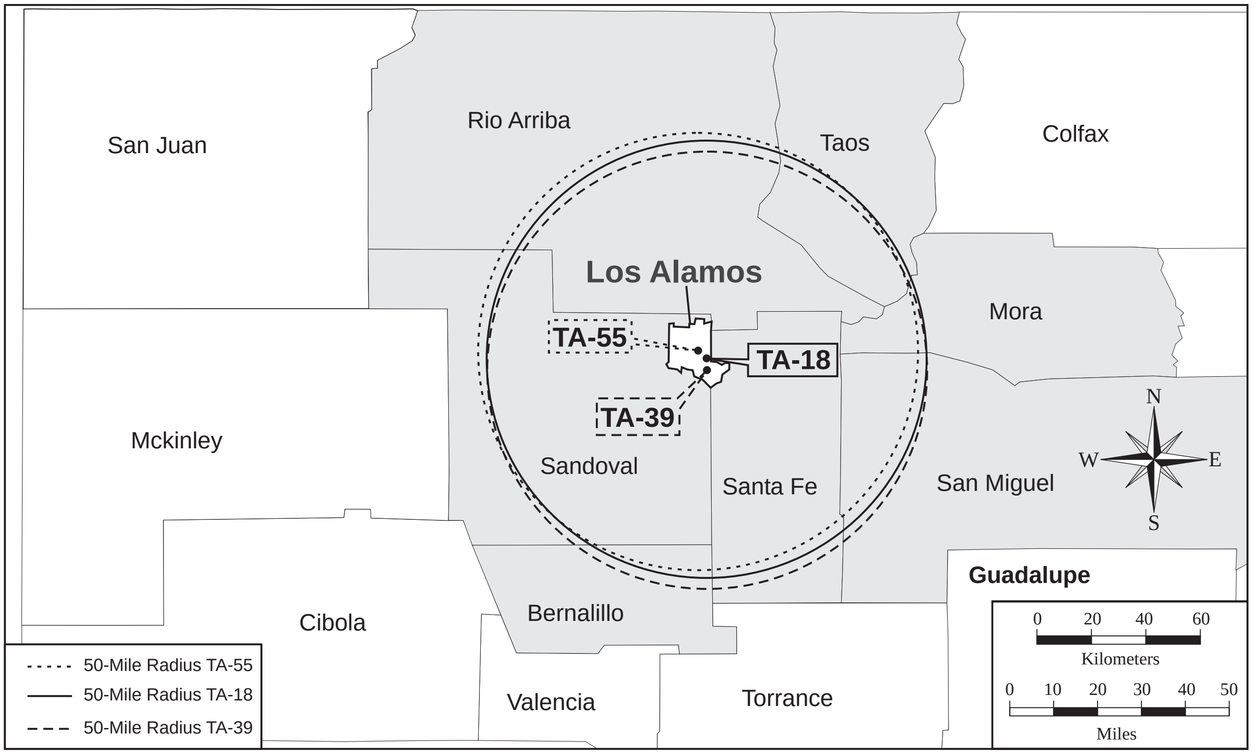

Figure E–2 Potentially Affected Counties near LANL

Table E–1 Populations in Potentially Affected Counties Surrounding LANL in 2000

Population Group	*Population*	*Percentage of Total*
Total	900,696	100.0
Minority	488,850	54.3
Hispanic/Latino	400,673	44.5
Black/African American	16,204	1.8
American Indian/Alaska Native	44,430	4.9
Asian	13,195	1.5
Native Hawaiian/Pacific Islander	607	0.1
Two or More Races	13,741	1.5
Some Other Race	1,498	0.2
White	410,348	45.6

Data shown in Table E–1 reflect the results of Census 2000. The Hispanic or Latino population shown in Table E–1 includes persons of any race who designated themselves as having Hispanic or Latino origins. Populations for each race shown in the last seven rows of Table E–1 did not characterize themselves as having Hispanic or Latino origins. As discussed in Section E.2 above, persons indicating that they were multiracial are included in the estimate of the minority population given in the second row of the table. Approximately two percent of the total U.S. population selected two or more races during Census 2000. Of those, approximately one-third selected "White" and "Some Other Race." Since "White" and "Other Race" are not included in the CEQ current definition of minority races (CEQ 1997), the minority population shown in Table E–1 is overestimated. However, since non-Hispanic persons in the group "Two or More Races" were less than two percent of the total population of these counties in 2000, the overestimate is relatively small.

Figure E–3 compares Census 2000 data with that for 1990 (to the extent that the data can be compared). There are several reasons that minority data from Census 1990 cannot be directly compared with Census 2000 data. During the 1990 Census, Asian and Pacific Islanders were counted together in a single category. However, during Census 2000, "Native Hawaiian and Other Pacific Islander" and "Asian" were separate responses (selection of either one or both was an option). As a result, the 1990 population composed of Native Hawaiian and Other Pacific Islanders cannot be identified as a population distinct from Asians. In addition, during the 1990 Census, respondents were asked to designate themselves as members of only a single race. During Census 2000, respondents could select any combination of all of the six single race categories. As indicated in Figure E–3, there is no multiracial data available from the 1990 Census.

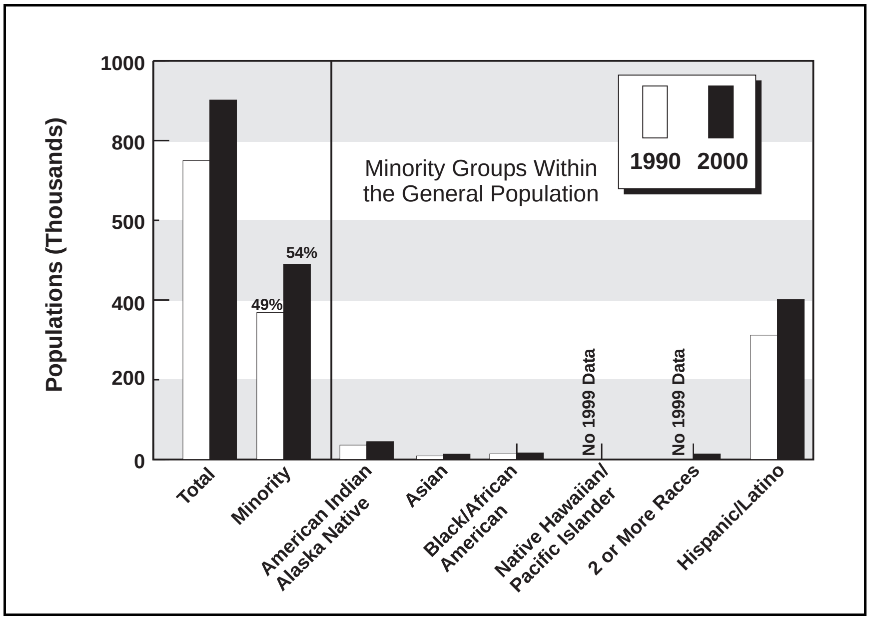

Figure E–3 Comparison of County Populations near LANL in 1990 and 2000

Bearing in mind the changes in racial categories and enumeration that occurred between the 1990 Census and Census 2000, the following approximate comparison can be made. In the decade from 1990 to 2000, the minority population in potentially affected counties increased from approximately 49 percent to 54 percent. Hispanics and American Indians composed approximately 91 percent of the total minority population. This is commensurate with characteristics of the State of New Mexico. In the same decade, the percentage minority population of New Mexico increased from approximately 49 percent to 55 percent. As a percentage of the total population in 1990, New Mexico had the largest minority population among all of the contiguous states. That was also found to be the case in the year 2000.

Figure E–4 shows the geographical distribution of minorities residing near LANL in 1990 using block group resolution. Shaded block groups shown in Figure E–4 indicate that the percentage minority population residing in those block groups exceeded that for the State of New Mexico as a whole and was more than twice the percentage minority population for the nation as a whole. **Figure E–5** shows the geographical distribution of the low-income population residing near LANL in 1990. In 1990, approximately 13 percent of the nation's resident population reported incomes below the poverty threshold, and approximately 21 percent of New Mexico's population was composed of low-income individuals. Shaded block groups in Figure E–5 indicate that the percentage low-income population residing in those block groups exceeded that for New Mexico as a whole and was more than twice the percentage low-income population for the nation as a whole.

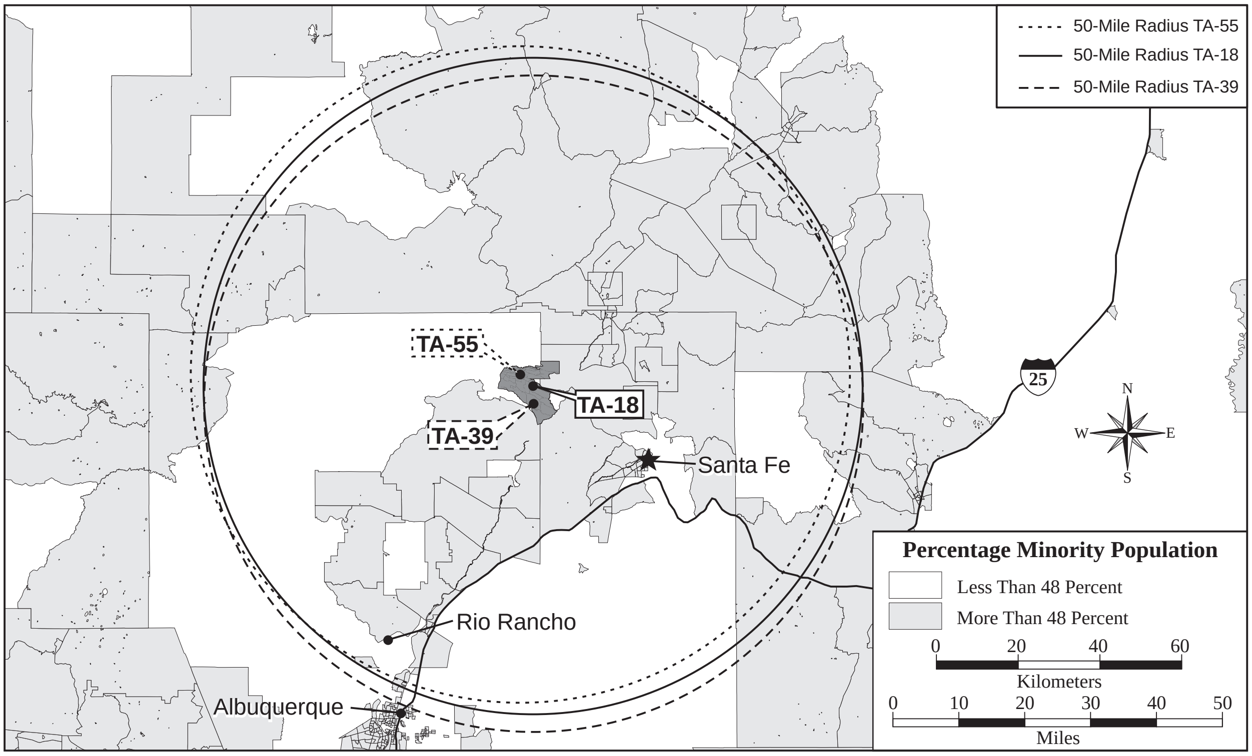

Figure E–4 Geographical Distribution of Minorities Residing near LANL

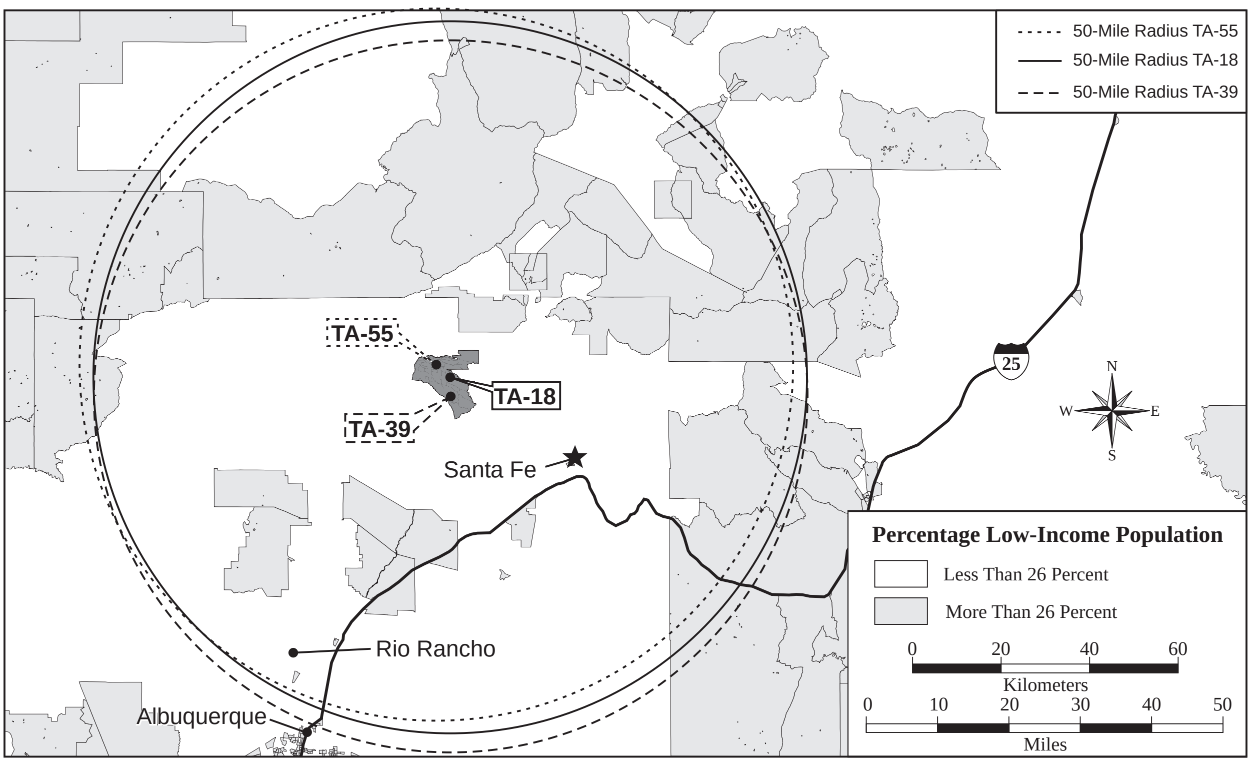

Figure E–5 Geographical Distribution of Low-Income Populations Residing near LANL

A total of approximately 156,350 minority individuals and 41,520 low-income persons resided within 80 kilometers (50 miles) of TA-39 in 1990. **Figure E–6** shows the cumulative percentage of these populations residing at a given distance from TA-39. For example, approximately 37 percent of the total minority population of 156,350 resided within 32 kilometers (20 miles) of TA-39, and approximately 33 percent of the total low-income population of 41,520 resided within 32 kilometers (20 miles) of TA-39. The curve representing percentages of minority residents (solid line in Figure E–6) is nearly identical in shape to that representing percentages of low-income residents (dashed line in Figure E–6). Both percentages rise sharply near the outskirts of the Cities of Santa Fe and Albuquerque. Approximately 2 percent of the minority population (3,269 minority individuals) and 1.5 percent of the low-income population (615 low-income individuals) reside within 16 kilometers (10 miles) of TA-39. As indicated in the figure, the majority population (dot-dashed line in Figure E–6) residing within 80 kilometers (50 miles) of TA-39 was relatively concentrated in the Cities of Santa Fe and Albuquerque in 1990. Low-income and minority residents were more noticeably distributed throughout the rural areas. As indicated by the similarities of the 80-kilometer (50-mile) bands shown in Figures E–4 and E–5, cumulative percentages of these populations for TA-18 and TA-55 are similar to those for TA-39.

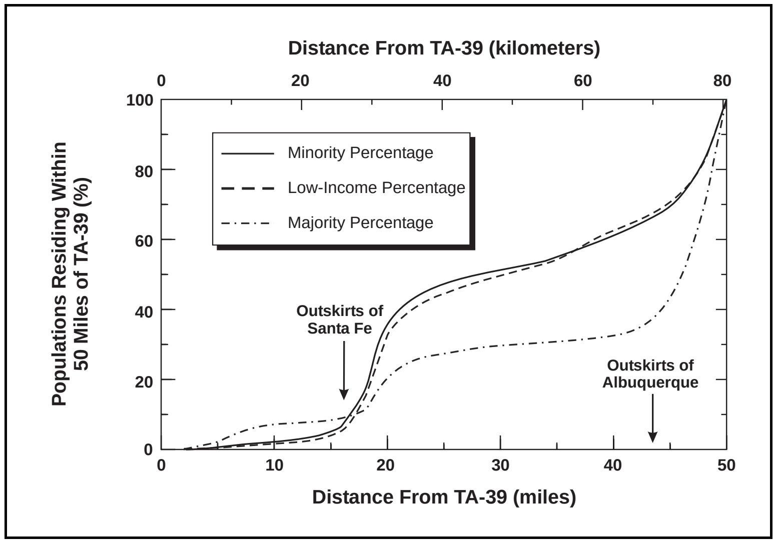

Figure E–6 Cumulative Percentage of Populations Residing within 80 Kilometers (50 Miles) of TA-39

Impacts of Construction on Minority and Low-Income Populations

As discussed in Chapter 3, construction at LANL would occur under implementation of all of the alternatives except the No Action Alternative. As discussed throughout Section 5.2, construction impacts at LANL would be small and would not be expected to extend beyond the LANL boundary. Construction activities at LANL would have little or no impact on surrounding minority and low-income populations.

Impacts of Normal Operations on Minority and Low-Income Populations

As discussed in Section 5.2.10.1, incident-free operations at LANL would result in the activation of from 10 curies to 110 curies of the radionuclide argon-41. Argon-41 is a colorless, inert gas with a half-life of approximately one hour and 48 minutes. The expected number of latent cancer fatalities among the general public surrounding LANL that would result from external exposure to argon-41 resulting from normal operations would be 5×10^{-5} or less. LANL is surrounded by Indian reservations that lie completely or partially within the area at radiological risk (see **Figure E–7**). Hence, subsistence consumption of radiologically-contaminated local crops and wildlife is a concern. However, argon-41 is a noble gas that decays into a stable isotope of potassium. No internal dose, either from ingestion or inhalation of argon-41, would result from normal operations at LANL. Therefore, normal operations would not pose a significant radiological risk to minority or low-income populations residing within the area at risk.

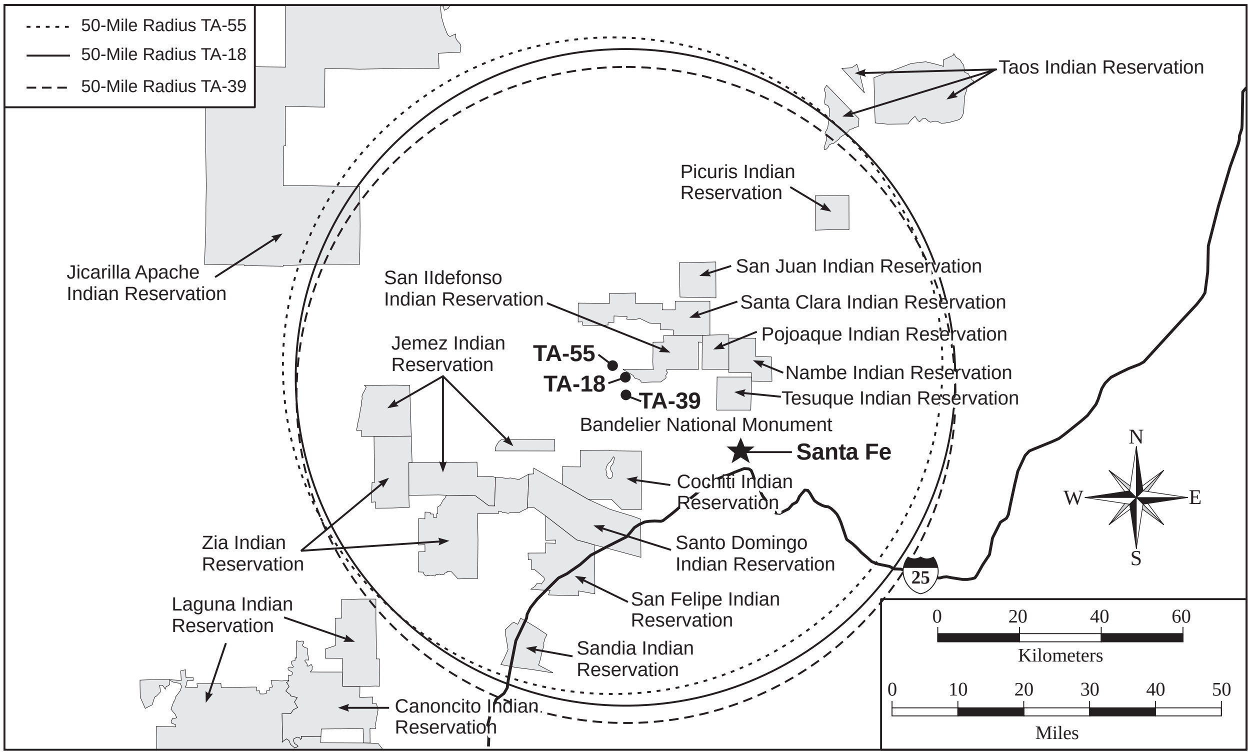

Figure E–7 Indian Reservations near LANL

Impacts of Accidents on Minority and Low-Income Populations

In terms of radiological risk, the most severe accident among those evaluated in this EIS would result in hydrogen denotation at SHEBA (Section 5.2.10.2 of Chapter 5). All accident risks to any member of the public are at least four orders of magnitude less than one latent cancer fatality. Hence, none of the postulated accidents would pose a significant radiological risk to the public, including minority and low-income individuals and groups within the population at risk.

As discussed in Section C.2 of Appendix C, consequences due to accidents were calculated with the MACCS2 Model. This model evaluates doses due to inhalation of aerosols, such as respirable plutonium, and exposure to the plume. Longer term effects including resuspension/inhalation and ingestion of contaminated crops, wildlife, and fish are not included in the calculation. Such effects are largely controllable through interdiction. In order to conservatively estimate the radiological dose due to inhalation, the deposition velocity was set equal to zero during the MACCS2 calculations. Radioactive materials that would be deposited on surfaces remained airborne and available for inhalation. Given the rarity of accidents that could impact offsite individuals and the conservatism in the calculations of inhaled dose, implementation of the No Action Alternative or of any of the other proposed alternatives, each of which involves construction and retention of all or some of the TA-18 activities at LANL, would not be expected to pose a significant radiological risk to low-income or minority populations residing near LANL, including low-income and minority groups that depend upon subsistence consumption of locally grown crops and wildlife.

E.5.2 Sandia National Laboratories/New Mexico (SNL/NM)

Under the SNL/NM Alternative, security Category I/II activities currently conducted at TA-18 would be relocated to TA-V at SNL/NM. Security Category III/IV and SHEBA activities would remain at LANL. **Figure E–8** and **Table E–2** show the counties at radiological risk and the composition of the populations of those counties, respectively. The counties are: Bernalillo, Cibola, McKinley, Sandoval, San Miguel, Santa Fe, Socorro, Torrance, and Valencia. Four of these counties (Bernalillo, Sandoval, Santa Fe, and San Miguel) would also be potentially affected by activities that would occur at LANL.

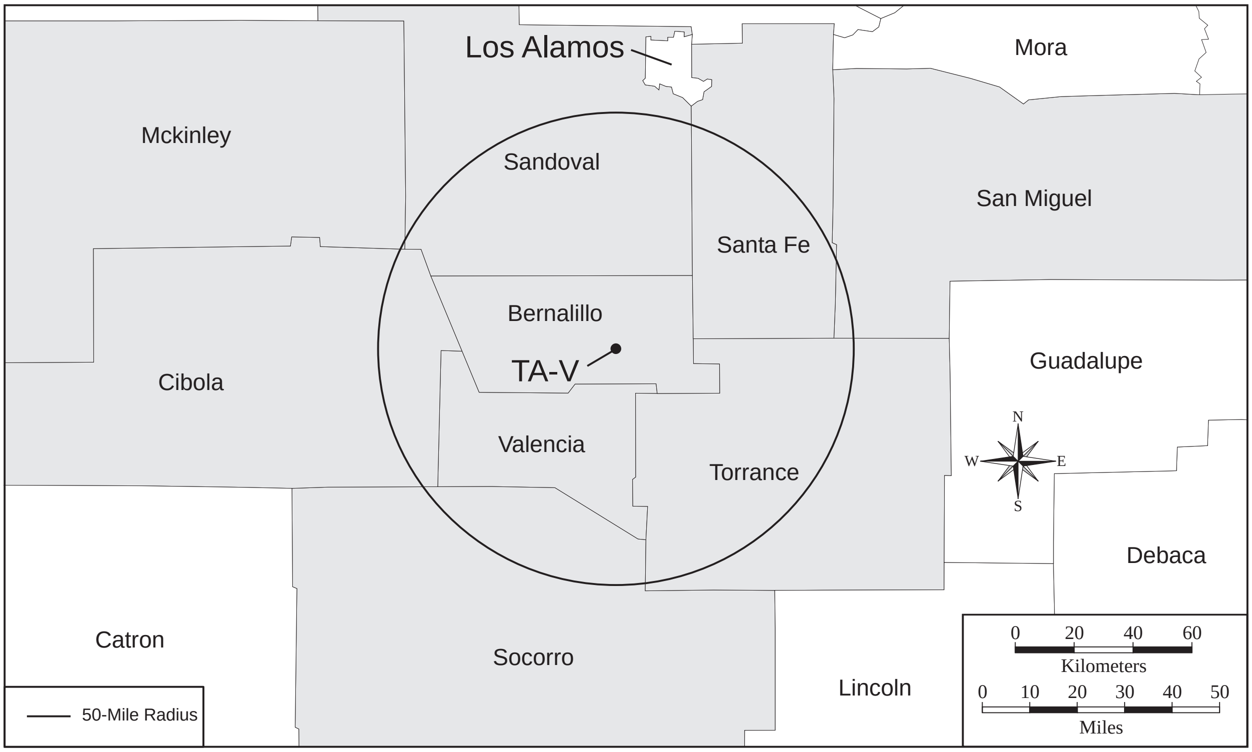

Figure E–8 Potentially Affected Counties Surrounding SNL/NM

Table E–2 Populations in Potentially Affected Counties Surrounding SNL/NM in 2000

Population Group	***Population***	***Percentage of Total***
Total	1,007,538	100.0
Minority	569,428	56.5
Hispanic/Latino	416,189	41.3
Black/African American	17,533	1.7
American Indian/Alaska Native	106,093	10.5
Asian	13,213	1.3
Native Hawaiian/Pacific Islander	647	0.1
Two or More Races	15,753	1.6
Some Other Race	1,644	0.2
White	436,466	43.3

Data shown in Table E–2 reflects the results of Census 2000. The Hispanic or Latino population shown in Table E–2 includes persons of any race who designated themselves as having Hispanic or Latino origins. Populations for each race shown in the last seven rows of Table E–2 did not characterize themselves as having Hispanic or Latino origins. As discussed in Section E.2 above, persons indicating that they were multiracial are included in the estimate of the minority population given in the second row of the table. Approximately two percent of the total U.S. population selected two or more races during Census 2000. Of those, approximately one-third selected "White" and "Some Other Race." Since "White" and "Other Race" are not included in the CEQ's current definition of minority races (CEQ 1997), the minority population shown in Table E–2 is overestimated. However, since non-Hispanic persons in the group "Two or More

Races" were less than two percent of the total population of these counties in 2000, the overestimate is relatively small.

Figure E–9 compares Census 2000 data with that for 1990 (to the extent that the data can be compared). There are several reasons that minority data from Census 1990 cannot be directly compared with Census 2000 data. During the 1990 Census, Asian and Pacific Islanders were counted together in a single category. However, during 2000 Census, "Native Hawaiian and Other Pacific Islander" and "Asian" were separate responses (selection of either one or both was an option). As a result, the 1990 population composed of Native Hawaiian and Other Pacific Islanders cannot be identified as a population distinct from Asians. In addition, during the 1990 Census, respondents were asked to designate themselves as members of only a single race. During Census 2000, respondents could select any combination of all of the six single race categories. As indicated in Figure E–9, there is no multiracial data available from the 1990 Census.

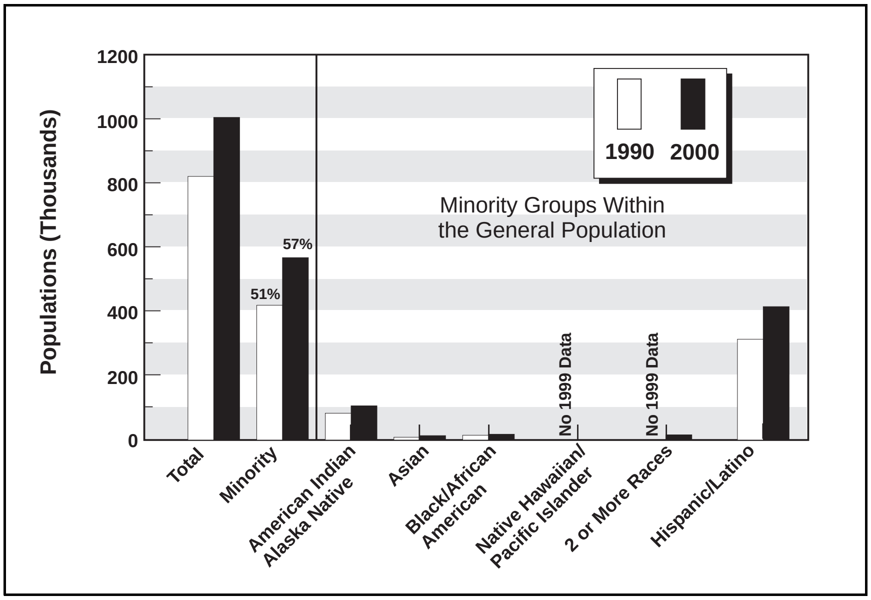

Figure E–9 Comparison of Potentially Affected County Populations near SNL/NM in 1990 and 2000

Bearing in mind the changes in racial categories and enumeration that occurred between the 1990 Census and Census 2000, the following approximate comparison can be made. In the decade from 1990 to 2000, the minority population in potentially affected counties increased from approximately 51 percent to 57 percent. Hispanics and American Indians composed approximately 92 percent of the total minority population. This is commensurate with characteristics of the State of New Mexico. In the same decade, the percentage minority population of New Mexico increased from approximately 49 percent to 55 percent. As a percentage of the total population in 1990, New Mexico had the largest minority population among all of the contiguous states. That was also found to be the case in the year 2000.

Figure E–10 shows the geographical distribution of minorities residing near TA-V in 1990 using block group resolution. Shaded block groups shown in Figure E–10 indicate that the percentage minority population residing in those block groups exceeded that for the State of New Mexico as a whole and was more than twice the percentage minority population for the nation as a whole. **Figure E–11** shows the geographical distribution of the low-income population residing near TA-V in 1990. In 1990, approximately 13 percent of the nation's resident population reported incomes below the poverty threshold, and approximately 21 percent of New Mexico's population was composed of low-income individuals. Shaded block groups in Figure E–11 indicate that the percentage low-income population residing in those block groups exceeded that for New Mexico as a whole and was more than twice the percentage low-income population for the nation as a whole.

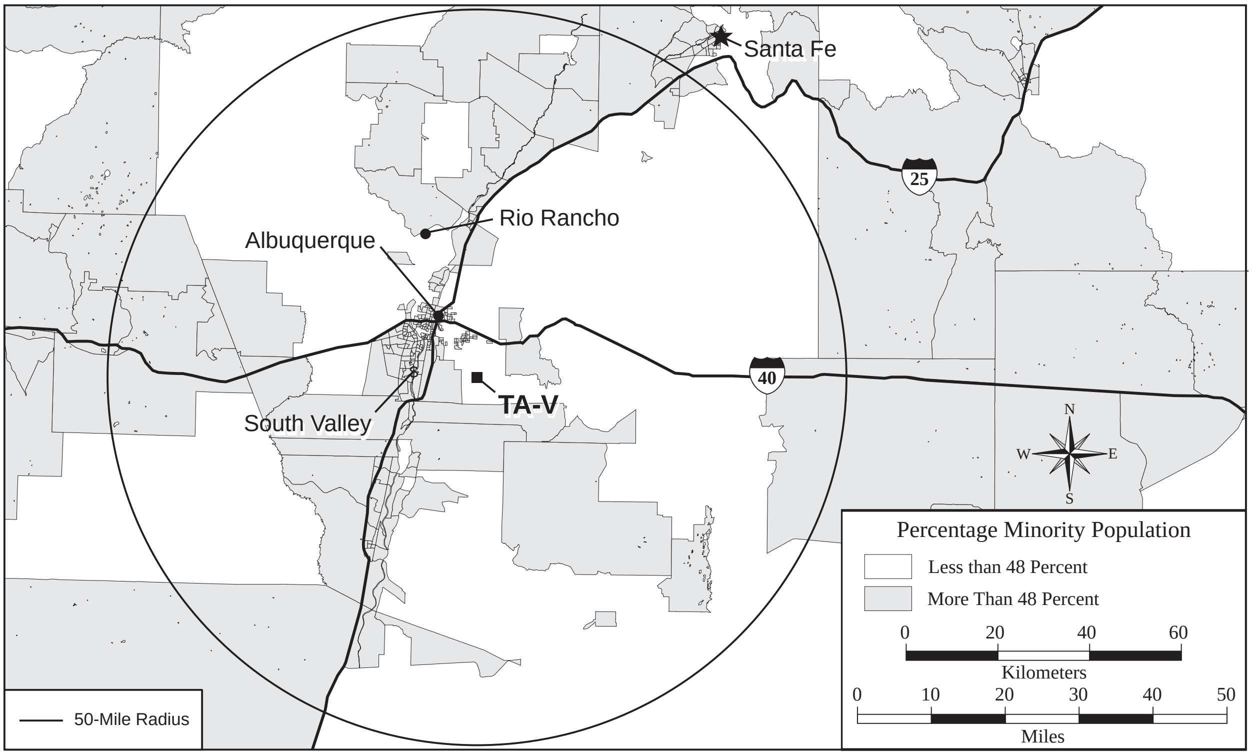

Figure E–10 Geographical Distribution of Minority Populations Residing near TA-V

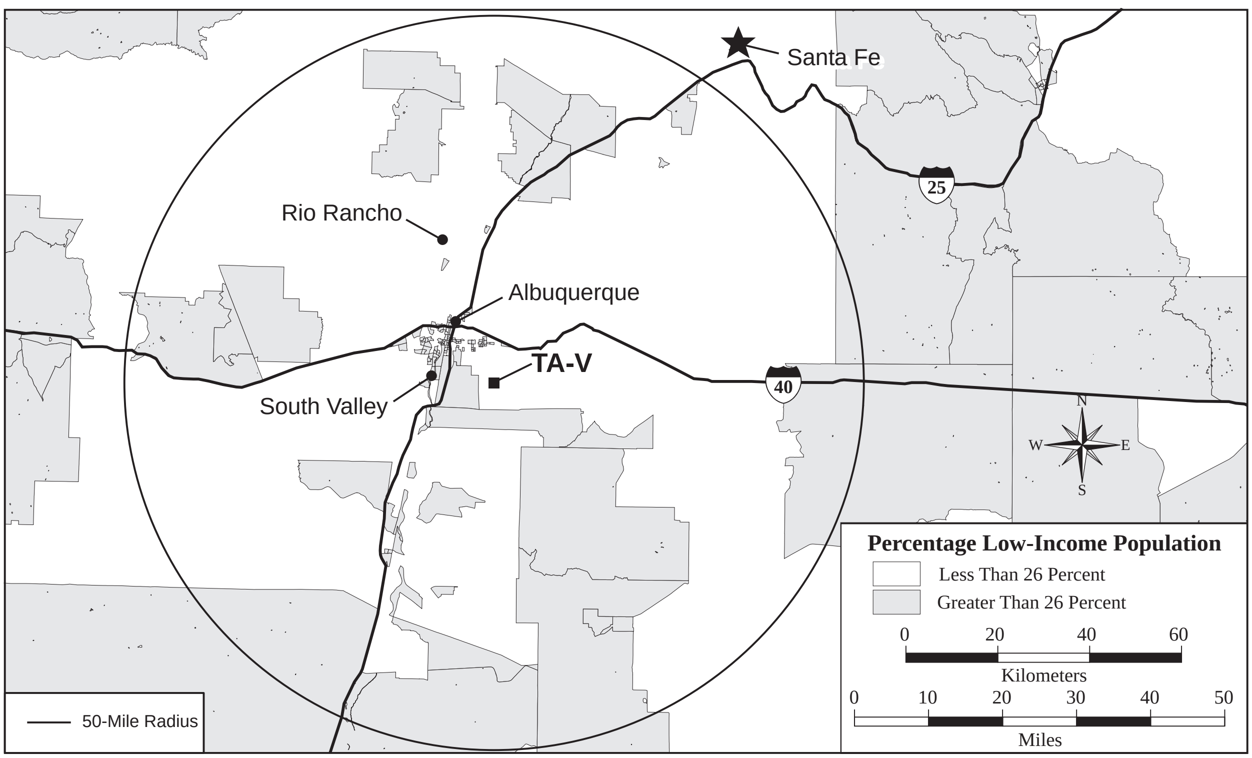

Figure E–11 Geographical Distribution of Low-Income Populations Residing near TA-V

A total of approximately 273,569 minority individuals and 89,146 low-income persons resided within 80 kilometers (50 miles) of TA-V in 1990. **Figure E–12** shows the cumulative percentage of these populations residing at a given distance from TA-V. For example, approximately 83 percent of the total minority population of 273,569 resided within 32 kilometers (20 miles) of TA-V, and approximately 83 percent of the total low-income population of 89,146 resided within 20 miles of TA-39. The curve representing percentages of minority residents (solid line in Figure E–12) is nearly identical in shape to that representing percentages of low-income residents (dashed line in Figure E–12). All percentages rise sharply near the boundary of Kirtland Air Force Base. Approximately 43 percent of the minority population (113,502 minority individuals) and 49 percent of the low-income population (43,437 low-income individuals) reside within 16 kilometers (10 miles) of TA-V. All of the population groups represented in Figure E–12 are concentrated in the Albuquerque metropolitan area.

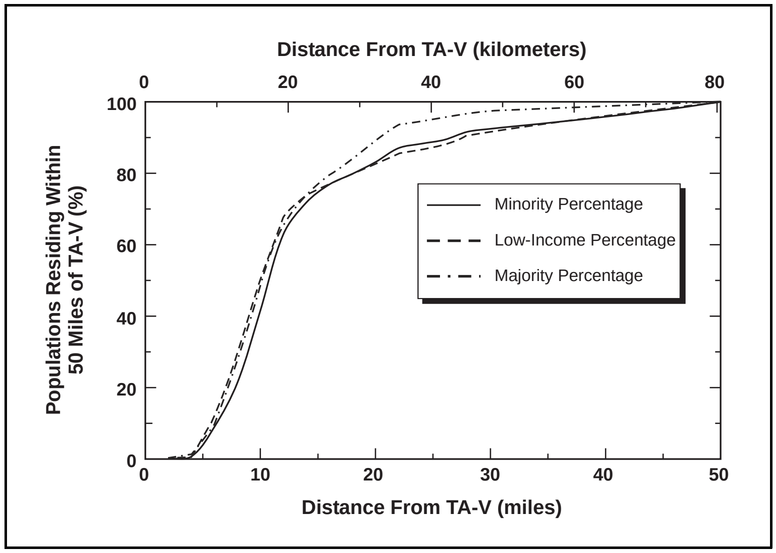

Figure E–12 Cumulative Percentage of Populations Residing within 80 Kilometers (50 Miles) of TA-V

Impacts of Construction on Minority and Low-Income Populations

Construction of new facilities at TA-V would occur under implementation of the SNL/NM Alternative. As discussed throughout Section 5.3, construction impacts at TA-V would be small and would not be expected to extend beyond the boundary of Kirtland Air Force Base. Construction activities at TA-V would have little or no impact on the surrounding minority and low-income populations.

Impacts of Normal Operations on Minority and Low-Income Populations

As discussed in Section 5.3.10.1, incident-free operations at TA-V would result in the activation of 10 curies per year of the radionuclide argon-41. Argon-41 is a colorless, inert gas with a half-life of approximately one hour and 48 minutes. The expected number of latent cancer fatalities that would result from external exposure to argon-41 among the general public surrounding SNL/NM would be approximately 1×10^{-5}. SNL/NM is surrounded by Indian reservations that lie completely or partially within the area at radiological risk (see **Figure E–13**). Hence, subsistence consumption of radiologically-contaminated local crops and wildlife is a concern. However, argon-41 is a noble gas that decays into a stable isotope of potassium. No internal dose, either from ingestion or inhalation of argon-41, would result from normal operations at TA-V. Therefore, normal operations conducted under the SNL/NM Alternative would not pose a significant radiological risk to resident minority or low-income populations.

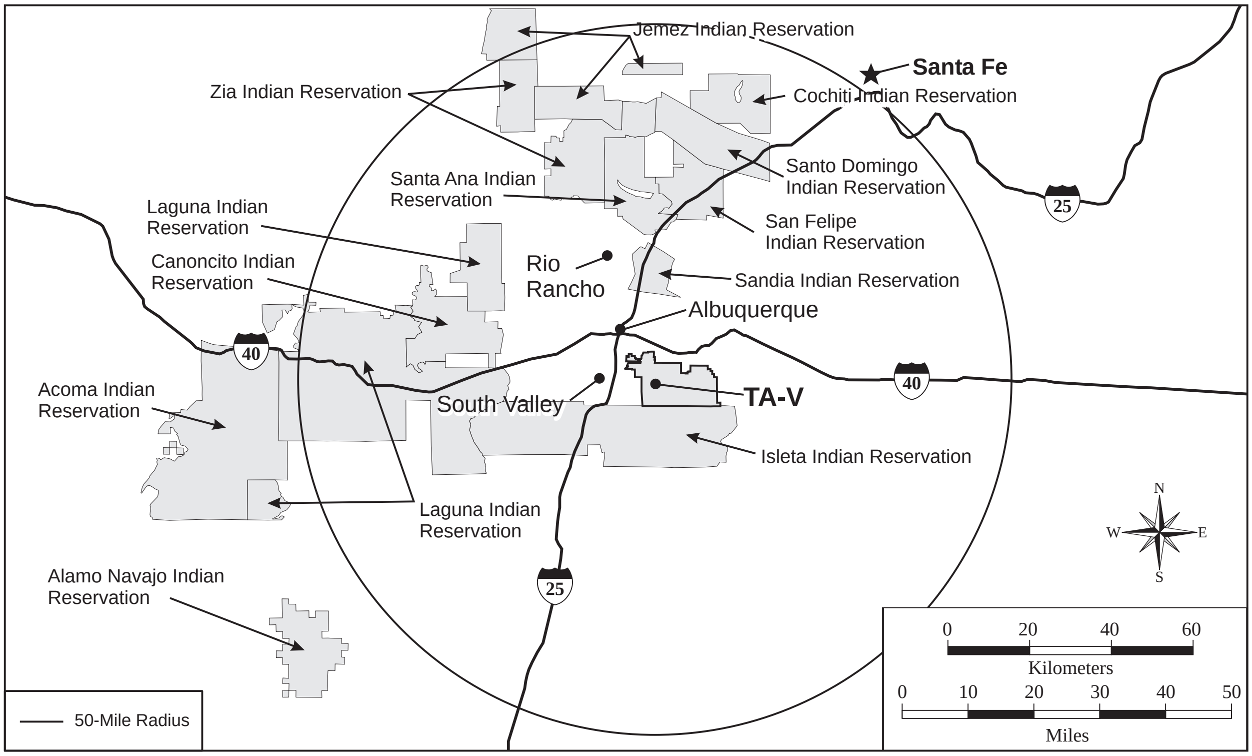

Figure E–13 Indian Reservations near TA-V

Impacts of Accidents on Minority and Low-Income Populations

In terms of radiological consequences and risk to the offsite public, the most severe accident among those evaluated in this EIS would result in a high pressure spray fire at TA-V (Section 5.3.10.2 of Chapter 5). All accident risks to any member of the public are at least seven orders of magnitude less than one latent cancer fatality. Hence, none of the postulated accidents would pose a significant radiological risk to the public, including minority and low-income individuals and groups within the population at risk.

As discussed in Section C.2 of Appendix C, consequences due to accidents were calculated with the MACCS2 Model. This model evaluates doses due to inhalation of aerosols, such as respirable plutonium, and exposure to the plume. Longer term effects including resuspension/inhalation and ingestion of contaminated crops, wildlife, and fish are not included in the calculation. Such effects are largely controllable through interdiction. In order to conservatively estimate the radiological dose due to inhalation, the deposition velocity was set equal to zero during the MACCS2 calculations. Radioactive materials that would be deposited on surfaces remained airborne and available for inhalation. Given the rarity of accidents that could impact offsite individuals and the conservatism in the calculations of inhaled dose, implementation of the SNL/NM Alternative would not be expected to pose a significant radiological risk to resident low-income or minority populations, including low-income and minority groups that depend upon subsistence consumption of locally grown crops and wildlife.

E.5.3 Nevada Test Site (NTS)

Under the NTS Alternative, security Category I/II activities currently conducted at TA-18 would be relocated to the Device Assembly Facility (DAF) at NTS. Security Category III/IV and SHEBA activities would remain at LANL. **Figure E–14** and **Table E–3** show the counties at radiological risk under implementation of the NTS Alternative and the composition of the population of these counties, respectively. The Counties

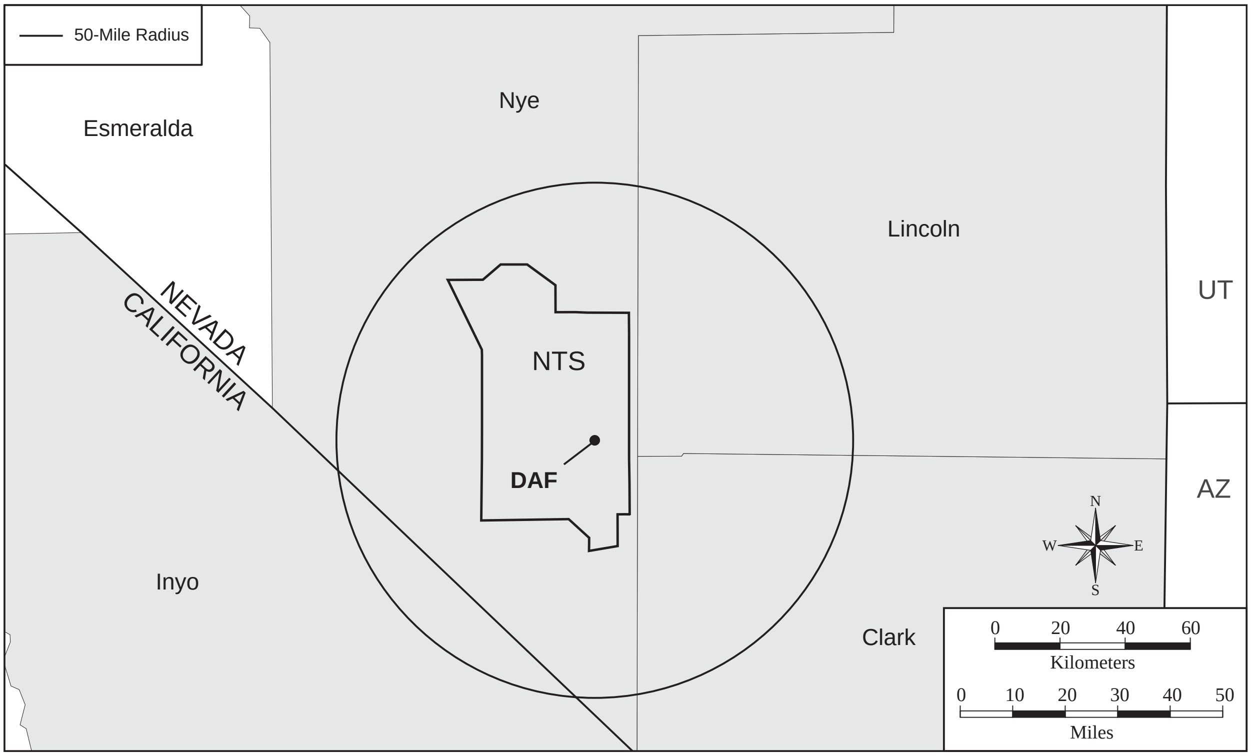

Figure E–14 Potentially Affected Counties near DAF

in Nevada are: Clark, Lincoln, and Nye. A portion of Inyo County, California is also within the area of potential radiological effects.

Table E–3 Populations in Potentially Affected Counties Surrounding DAF in 2000

Population Group	*Population*	*Percent of Total*
Total	1,430,360	100.0
Minority	554,986	38.8
Hispanic/Latino	307,334	21.5
Black/African American	121,865	8.5
American Indian/Alaska Native	10,092	0.7
Asian	71,639	5.0
Native Hawaiian/Pacific Islander	5,980	0.4
Two or More Races	38,076	2.7
Some Other Race	2,133	0.1
White	873,241	61.1

Data shown in the Table E–3 reflects the results of Census 2000. The Hispanic or Latino population shown in Table E–3 includes persons of any race who designated themselves as having Hispanic or Latino origins. Populations for each race shown in the last seven rows of Table E–3 did not characterize themselves as having Hispanic or Latino origins. As discussed in Section E.2 above, persons indicating that they were multiracial are included in the estimate of the minority population given in the second row of the table. Approximately two percent of the total U.S. population selected two or more races during Census 2000. Of those, approximately one-third selected "White" and "Some Other Race." Since "White" and "Other Race" are not included in the CEQ's current definition of minority races (CEQ 1997), the minority population shown in Table E–3 is overestimated. However, since non-Hispanic persons in the group "Two or More

Races" were less than three percent of the total population of these counties in 2000, the overestimate is relatively small.

Figure E–15 compares Census 2000 data with that for 1990 (to the extent that the data can be compared). There several reasons that minority data from Census 1990 cannot be directly compared with Census 2000 data. During the 1990 Census, Asian and Pacific Islanders were counted together in a single category. However, during Census 2000, "Native Hawaiian and Other Pacific Islander" and "Asian" were separate responses (selection of either one or both was an option). As a result, the 1990 population composed of Native Hawaiian and Other Pacific Islanders cannot be identified as a population distinct from Asians. In addition, during the 1990 Census, respondents were asked to designate themselves as members of only a single race. During Census 2000, respondents could select any combination of all of the six single race categories. As indicated in Figure E–15, there is no multiracial data available from the 1990 Census.

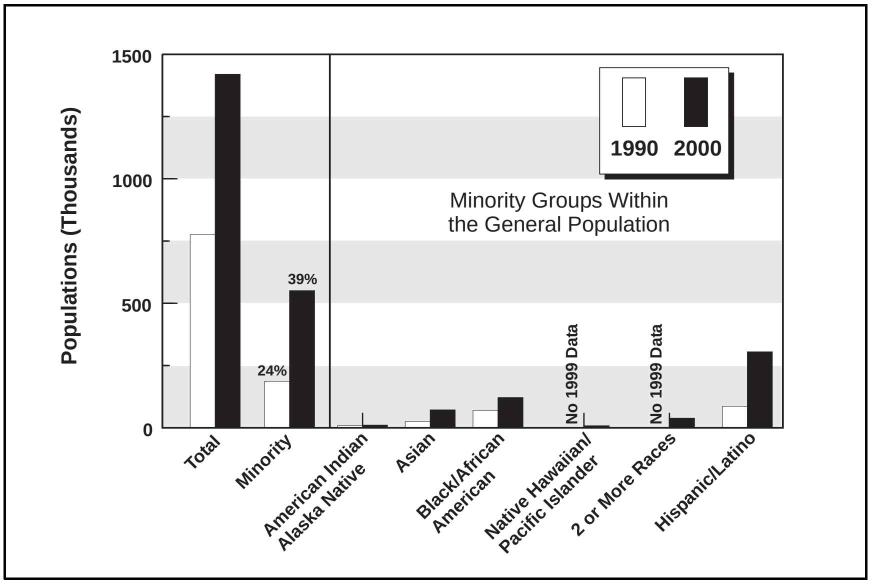

Figure E–15 Comparison of Potentially Affected County Populations near DAF in 1990 and 2000

Bearing in mind the changes in racial categories and enumeration that occurred between the 1990 Census and the 2000 Census, the following approximate comparison can be made. In the decade from 1990 to 2000, Nevada was the fastest growing state in the U.S. The minority population in potentially affected counties increased from approximately 24 percent to 39 percent. The Hispanic or Latino population of these counties more than tripled during the past decade, and the Asian population of those counties nearly tripled during the same decade. Nearly 70 percent of the population of the State of Nevada was found to reside in the Las Vegas metropolitan area of Clark County during Census 2000. Populations shown in Figure E–15 largely reflect the racial and Hispanic composition of Clark County.

Figure E–16 shows the geographical distribution of minorities residing near the DAF in 1990 using block group resolution. Shaded block groups shown in Figure E–16 indicate that the percentage minority population residing in those block groups exceeded that for the nation and State of Nevada as a whole. **Figure E–17** shows the geographical distribution of the low-Income population residing near the DAF. In 1990, approximately 13 percent of the nation's resident population reported incomes below the poverty threshold, and approximately 10 percent of Nevada's population was composed of low-income individuals. Shaded block groups in Figure E–17 indicate that the percentage low-income population residing in those block groups was more than national and state percentages of low-income residents.

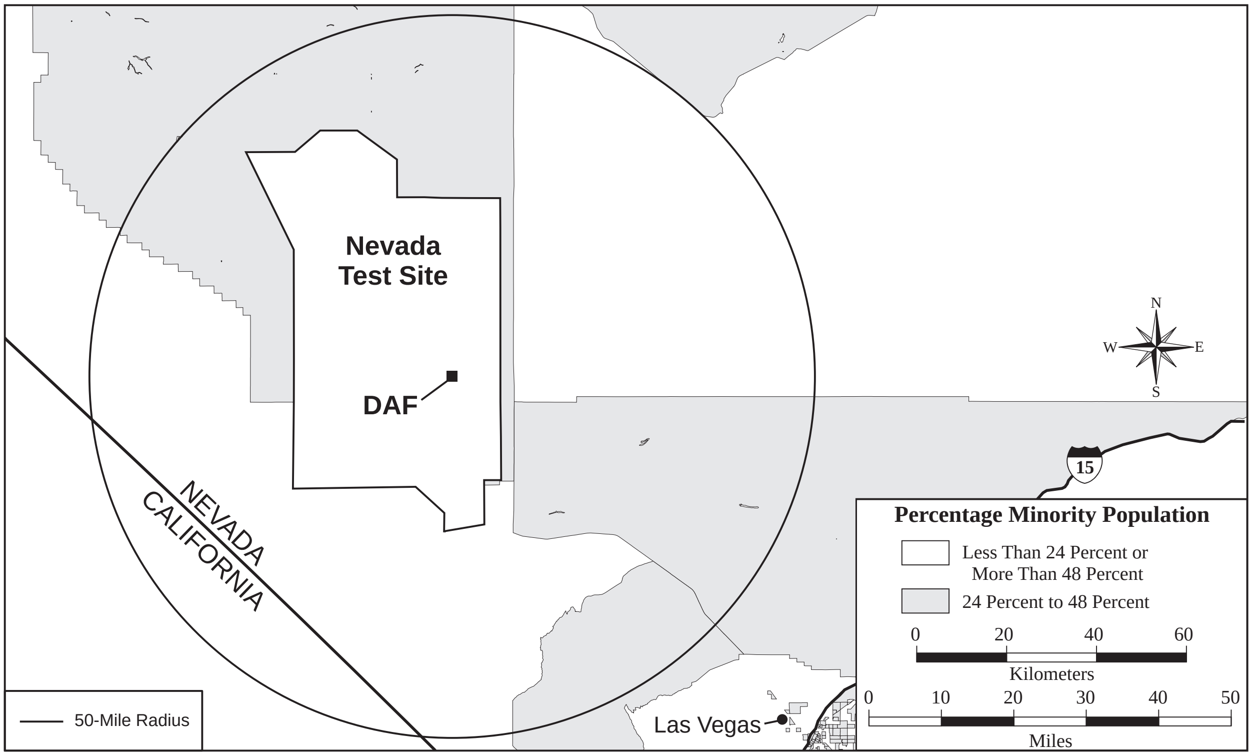

Figure E–16 Geographical Distribution of the Minority Population Residing near the DAF

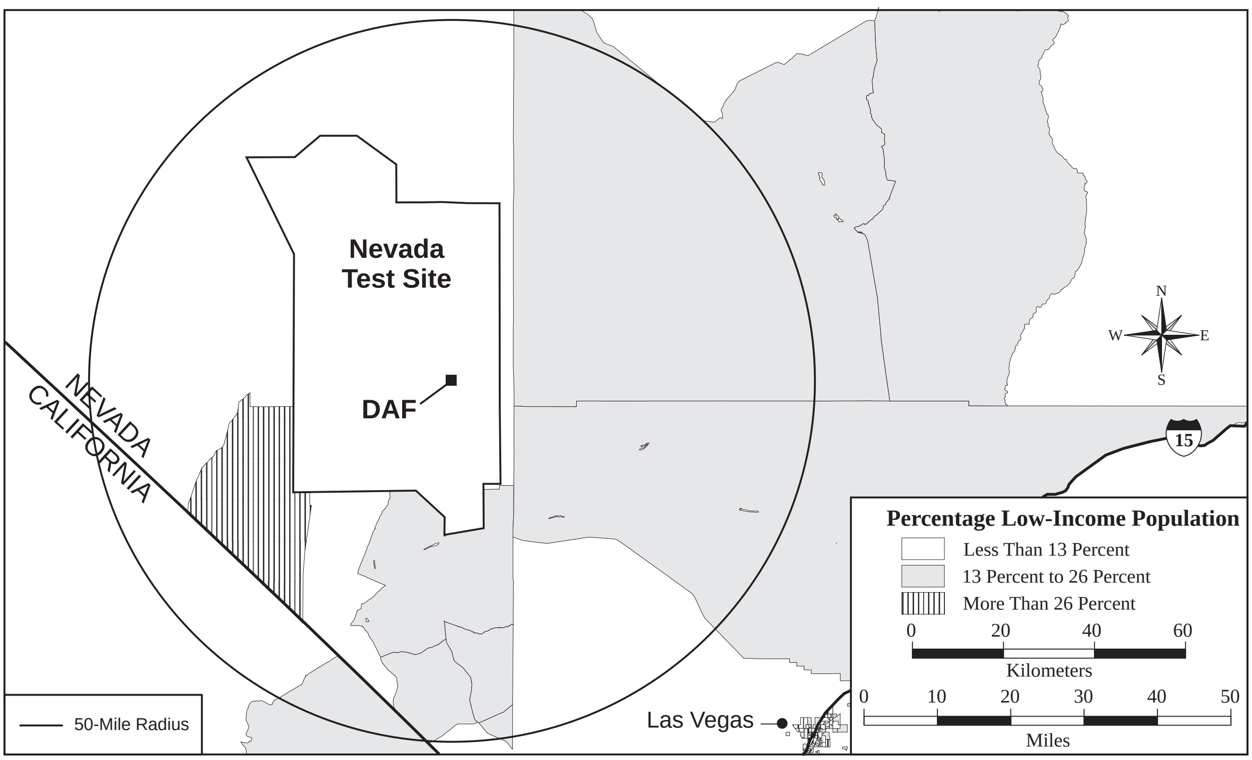

Figure E–17 Geographical Distribution of the Low-Income Population Residing near the DAF

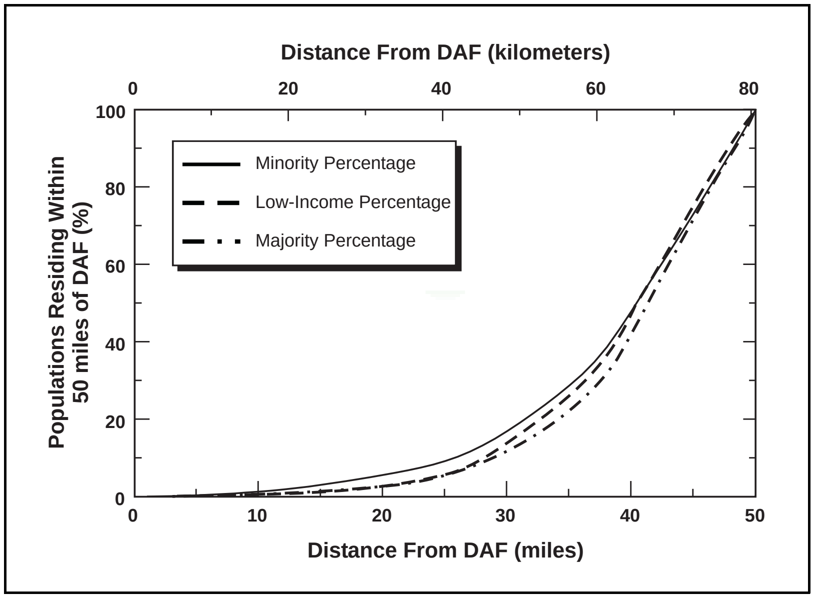

Figure E–18 Cumulative Percentage Population Residing within 80 Kilometers (50 Miles) of DAF

Approximately 1,710 minority individuals and 1,345 low-income persons resided within 80 kilometers (50 miles) of the DAF in 1990. **Figure E–18** shows the cumulative percentage of these populations residing at a given distance from the DAF. For example, approximately 6 percent of the total minority population of 1,710 resided within 32 kilometers (20 miles) of DAF, and approximately 3 percent of the total low-income population of 1,345 resided within 32 kilometers (20 miles) of DAF. Curves representing potentially affected minority (solid line), low-income (dashed line), and majority populations (dot-dash line) in Figure E–18 are similar in shape. There are no major metropolitan areas in the potentially affected area. All three curves increase at approximately the same rate as the distance approaches that for the Las Vegas metropolitan area.

Impacts of Construction on Minority and Low-Income Populations

Construction of new facilities at the DAF would occur under implementation of the NTS Alternative. As discussed throughout Section 5.4, construction impacts at the DAF would be small and would not be expected to extend beyond the boundary of NTS. Construction activities at the DAF would have little or no impact on the surrounding minority and low-income populations.

Impacts of Normal Operations on Minority and Low-Income Populations

As discussed in Section 5.4.10.1, incident-free operations at DAF would result in the activation of 10 curies per year of the radionuclide argon-41. Argon-41 is a colorless, inert gas with a half-life of approximately one hour and 48 minutes. The expected number of latent cancer fatalities that would result from external exposure to argon-41 among the general public surrounding NTS would be approximately 4×10^{-8}. No internal dose, either from ingestion or inhalation of argon-41, would result from normal operations at DAF. Therefore, normal operations conducted under the NTS Alternative would not pose a significant radiological risk to resident minority or low-income populations.

Impacts of Accidents on Minority and Low-Income Populations

In terms of radiological consequences and risk to the offsite population, the most severe accident among those evaluated in this EIS would result in a high pressure spray fire at DAF (Section 5.4.10.2 of Chapter 5). All accident risks to any member of the public are essentially zero. Hence, none of the postulated accidents would pose a significant radiological risk to the public, including minority and low-income individuals and groups within the population at risk.

As discussed in Section C.2 of Appendix C, consequences due to accidents were calculated with the MACCS2 Model. This model evaluates doses due to inhalation of aerosols, such as respirable plutonium, and exposure to the plume. Longer term effects including resuspension/inhalation and ingestion of contaminated crops, wildlife, and fish are not included in the calculation. Such effects are largely controllable through interdiction. In order to conservatively estimate the radiological dose due to inhalation, the deposition velocity was set equal to zero during the MACCS2 calculations. Radioactive materials that would be deposited on surfaces remained airborne and available for inhalation. Given the rarity of accidents that could impact offsite individuals and the conservatism in the calculations of inhaled dose, implementation of the NTS Alternative would not be expected to pose a significant radiological risk to resident low-income or minority populations, including low-income and minority groups that depend upon subsistence consumption of locally grown crops and wildlife.

E.5.4 Argonne National Laboratory-West (ANL-W)

Under the ANL-W Alternative, security Category I/II activities currently conducted at TA-18 would be relocated to the vicinity of the Fuel Manufacturing Facility (FMF) and its environs at ANL-W. Security Category III/IV activities would remain at LANL. **Figure E–19** and **Table E–4** show the counties at radiological risk and the composition of the populations of these counties, respectively. The counties are: Bannock, Bingham, Blaine, Bonneville, Butte, Clark, Caribou, Custer, Fremont, Jefferson, Lemhi, Madison, Minidoka, and Power.

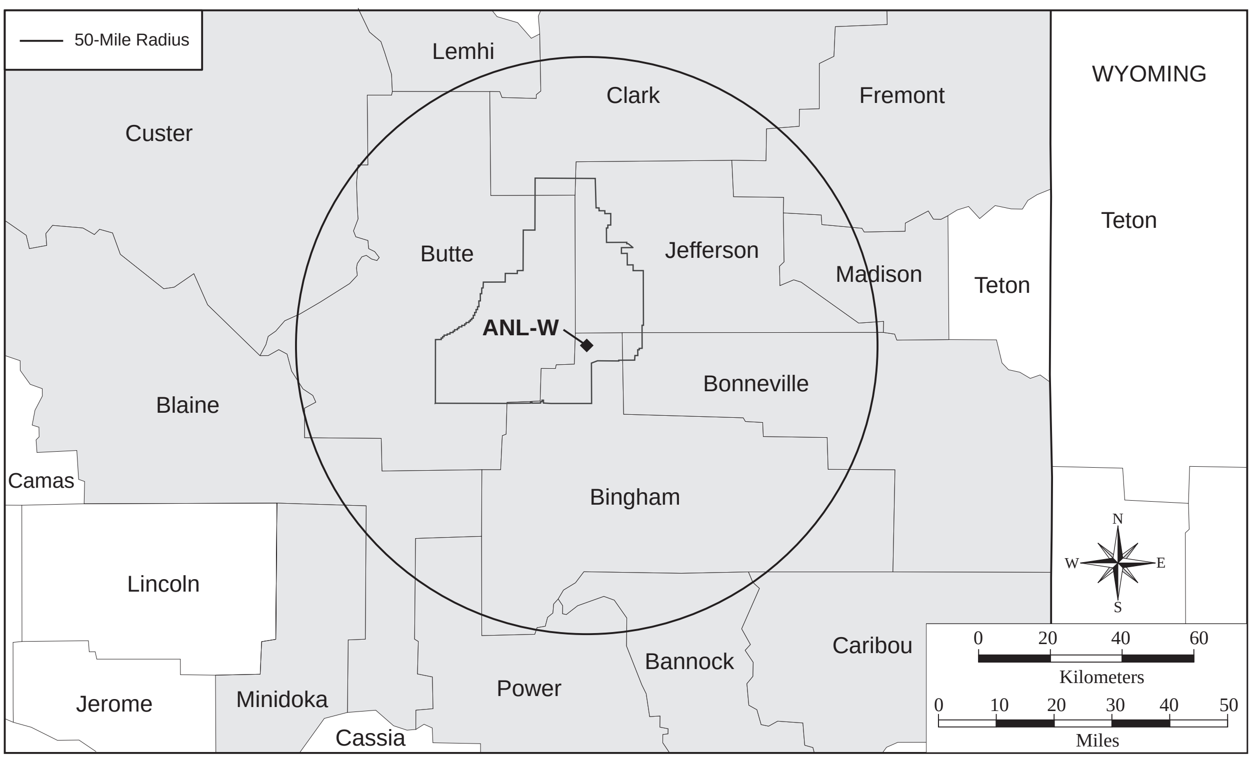

Figure E–19 Potentially Affected Counties near ANL-W

Data shown in Table E–4 reflects the results of Census 2000. The Hispanic or Latino population shown in Table E–4 includes persons of any race who designated themselves as having Hispanic or Latino origins. Populations for each race shown in the last seven rows of Table E–4 did not characterize themselves as having Hispanic or Latino origins. As discussed in Section E.2 above, persons indicating that they were multiracial are included in the estimate of the minority population given in the second row of the table.

Approximately two percent of the total U.S. population selected two or more races during the 2000 Census. Of those, approximately one-third selected "White" and "Some Other Race." Since "White" and "Other Race" are not included in the CEQ's current definition of minority races (CEQ 1997), the minority population shown in Table E–4 is overestimated. However, since non-Hispanic persons in the group "Two or More Races" were less than 2 percent of the total population of these counties in 2000, the overestimate is relatively small.

Table E–4 Populations in Potentially Affected Counties Surrounding ANL-W in 2000

Population Group	*Population*	*Percentage of Total*
Total	328,339	100.0
Minority	41,547	12.7
Hispanic/Latino	28,950	8.8
Black/African American	990	0.3
American Indian/Alaska Native	5,702	1.7
Asian	2,125	0.6
Native Hawaiian/Pacific Islander	277	0.1
Two or More Races	3,503	1.1
Some Other Race	225	0.1
White	286,567	87.3

Figure E–20 compares the 2000 Census data with that for 1990 (to the extent that the data can be compared). There are several reasons that minority data from Census 1990 cannot be directly compared with Census 2000 data. During the 1990 Census, Asian and Pacific Islanders were counted together in a single category. However, during Census 2000, "Native Hawaiian and Other Pacific Islander" and "Asian" were separate responses (selection of either one or both was an option). As a result, the 1990 population composed of Native Hawaiian and Other Pacific Islanders cannot be identified as a population distinct from Asians. In addition, during the 1990 Census, respondents were asked to designate themselves as members of only a single race. During Census 2000, respondents could select any combination of all of the six single race categories. As indicated in Figure E–20, there is no multiracial data available from the 1990 Census.

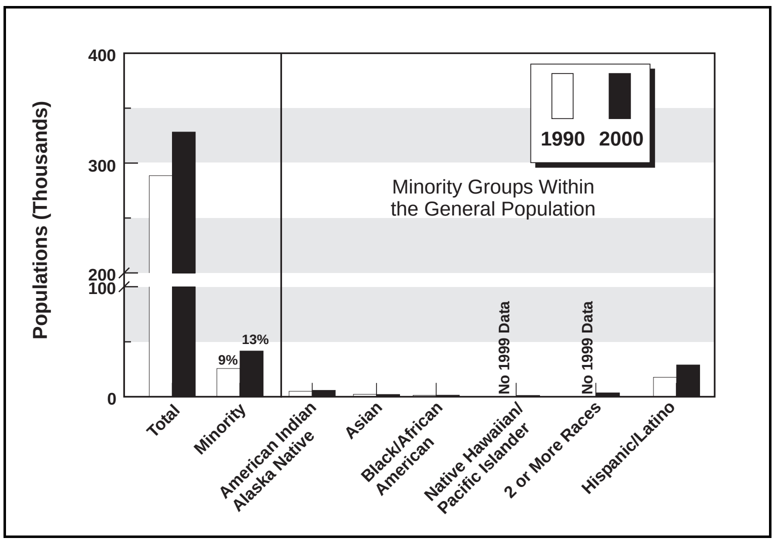

Figure E–20 Comparison of Potentially Affected County Populations near ANL-W in 1990 and 2000

Bearing in mind the changes in racial categories and enumeration that occurred between the 1990 Census and Census 2000, the following approximate comparison can be made. In the decade from 1990 to 2000, the minority population in potentially affected counties increased from approximately 9 percent to 13 percent. This is commensurate with characteristics of the State of Idaho. In the same decade, the percentage minority population of Idaho increased from approximately 8 percent to 12 percent.

Figure E–21 shows the geographical distribution of minorities residing near ANL-W in 1990 using block group resolution. Shaded block groups shown in Figure E–21 indicate that the percentage minority population residing in those block groups exceeded that for the nation as a whole and was more than three times the percentage minority population for the State of Idaho.

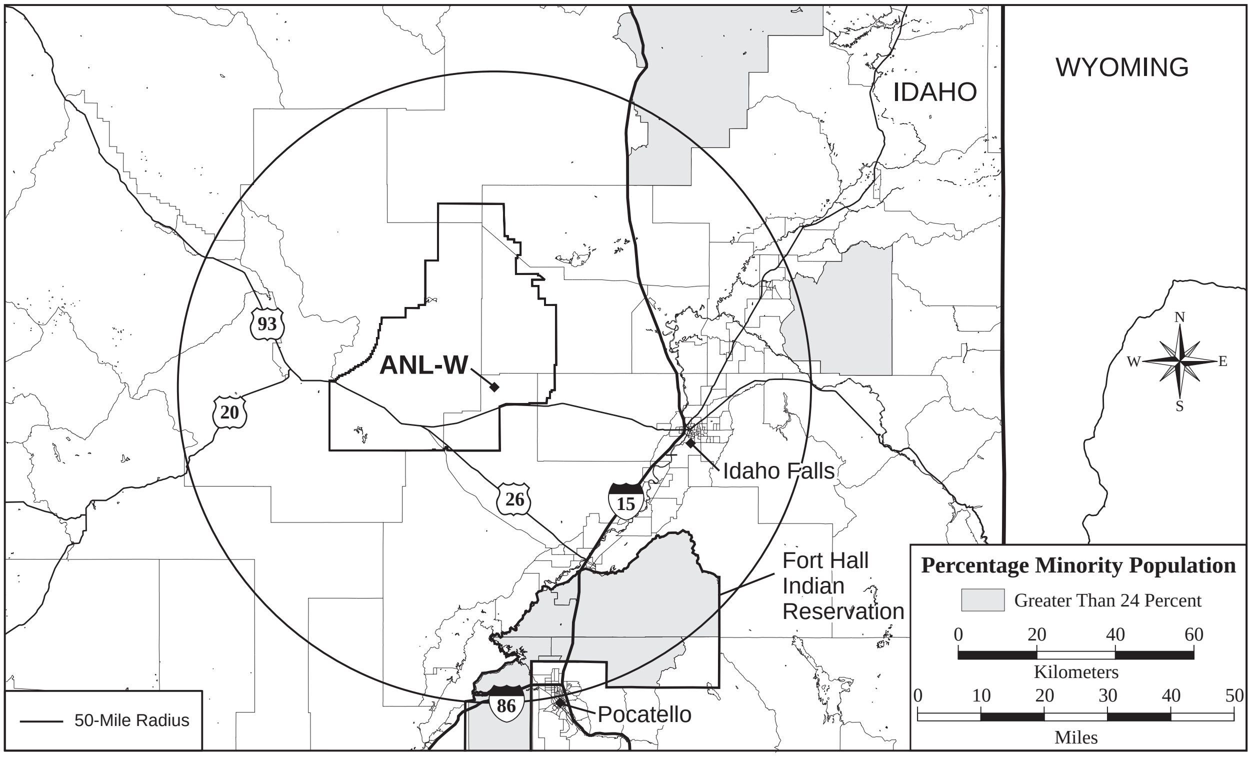

Figure E–21 Geographical Distribution of Minorities Residing near ANL-W

Figure E–22 shows the geographical distribution of the low-income population residing near ANL-W in 1990. In 1990, approximately 13 percent of the nation's resident population reported incomes below the poverty threshold, and approximately 13 percent of Idaho's population was composed of low-income individuals. Shaded block groups in Figure E–22 indicate that the percentage low-income population residing in those block groups exceeded that for Idaho and the nation.

A total of approximately 15,691 minority individuals and 25,045 low-income persons resided within 80 kilometers (50 miles) of ANL-W in 1990. **Figure E–23** shows the cumulative percentage of these populations residing at a given distance from ANL-W. For example, approximately 2 percent of the total minority population and approximately 1.5 percent of the total low-income population resided within 32 kilometers (20 miles) of FMF. The curve representing percentages of minority residents (solid line in Figure E–23) increases steadily throughout the potentially affected area. The percentage of low-income residents (dashed line) and majority residents (dot-dash line) rise sharply near the outskirts of the Cities of Idaho Falls and Pocatello. Less than 1 percent of the minority population (92 minority individuals) and low-income population (70 low-income individuals) reside within 16 kilometers (10 miles) of FMF.

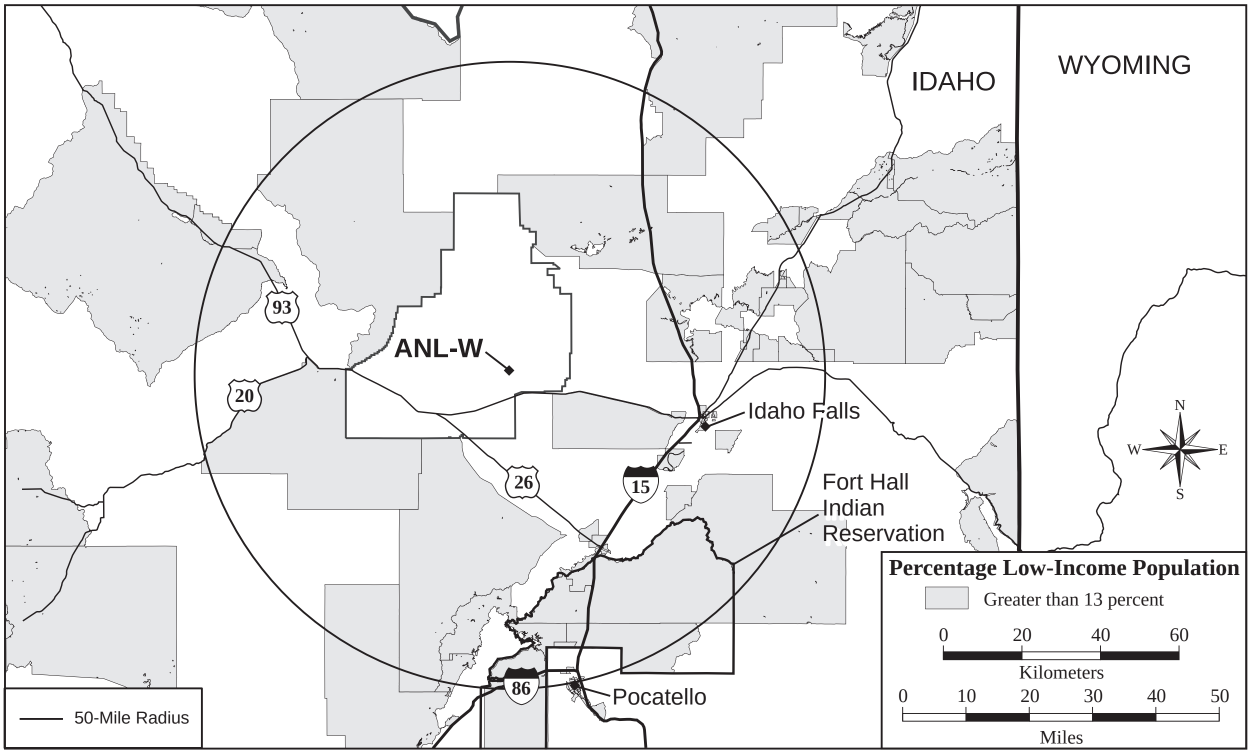

Figure E–22 Geographical Distribution of Low-Income Populations Residing near ANL-W

Impacts of Construction on Minority and Low-Income Populations

Modification of existing facilities and construction of new facilities at ANL-W would occur under implementation of this alternative. As discussed throughout Section 5.5, construction impacts at ANL-W would be small. Construction activities at ANL-W would have little or no impact on the surrounding minority and low-income populations.

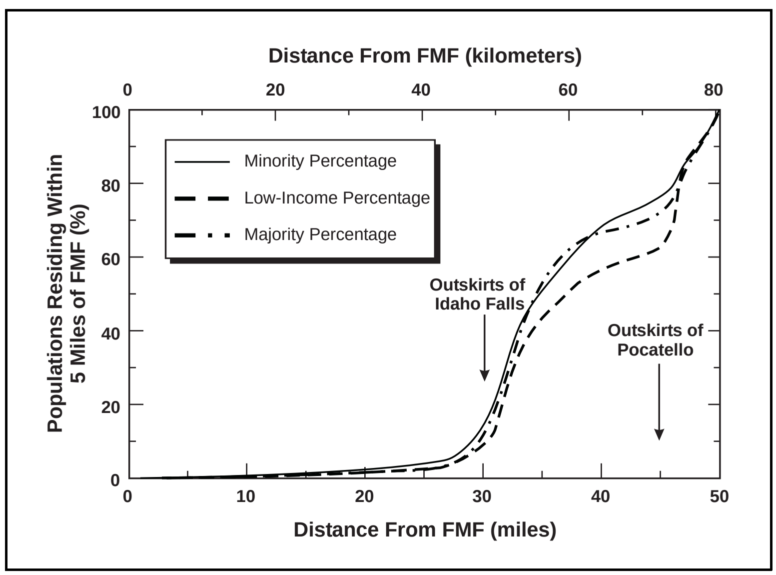

Figure E–23 Cumulative Percentage of Populations Residing within 80 Kilometers (50 Miles) of FMF

Impacts of Normal Operations on Minority and Low-Income Populations

As discussed in Section 5.5.10.1, incident-free operations at FMF would result in the activation of 10 curies per year of the radionuclide argon-41. Argon-41 is a colorless, inert gas with a half-life of approximately one hour and 48 minutes. The expected number of latent cancer fatalities that would result from external exposure to argon-41 among the general public surrounding ANL-W would be approximately 2×10^{-7}. No internal dose, either from ingestion or inhalation of argon-41, would result from normal operations at FMF. Therefore, normal operations conducted under the ANL-W Alternative would not pose a significant radiological risk to resident minority or low-income populations.

Impacts of Accidents on Minority and Low-Income Populations

In terms of radiological consequences and risk, the most severe accident among those evaluated in this EIS would result in a high pressure spray fire at FMF (Section 5.5.10.2 of Chapter 5). All accident risks to any member of the public are essentially zero. Hence, none of the postulated accidents would pose a significant radiological risk to the public, including minority and low-income individuals and groups within the population at risk.

As discussed in Section C.2 of Appendix C, consequences due to accidents were calculated with the MACCS2 Model. This model evaluates doses due to inhalation of aerosols, such as respirable plutonium, and exposure to the plume. Longer term effects including resuspension/inhalation and ingestion of contaminated crops, wildlife, and fish are not included in the calculation. Such effects are largely controllable through interdiction. In order to conservatively estimate the radiological dose due to inhalation, the deposition velocity was set equal to zero during the MACCS2 calculations. Radioactive materials that would be deposited on surfaces remained airborne and available for inhalation. Given the rarity of accidents that could impact offsite individuals and the conservatism in the calculations of inhaled dose, implementation of the ANL-W Alternative would not be expected to pose a significant radiological risk to resident low-income or minority populations, including low-income and minority groups that depend upon subsistence consumption of locally grown crops and wildlife.

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APPENDIX F

Environmental Impacts Methodology

TA-18

APPENDIX F
ENVIRONMENTAL IMPACTS METHODOLOGY

This appendix briefly describes the methods used to assess the potential direct, indirect, and cumulative effects of the alternatives in this *TA-18 Relocation Environmental Impact Statement (EIS)*. Included are impact assessment methods for land resources, site infrastructure, air quality, noise, geology and soils, water resources, ecological resources, cultural and paleontological resources, socioeconomics, waste management, and cumulative impacts. Each section includes descriptions of the affected resources, region of influence, and impact assessment methods. Descriptions of the methods for the evaluation of human health effects from normal operations, facility accidents, and transportation, and environmental justice are presented in Appendices B, C, D, and E, respectively.

Impact analyses vary for each resource area. For air quality, for example, estimated pollutant emissions from the candidate facilities were compared with appropriate regulatory standards or guidelines. Comparison with regulatory standards is a commonly used method for benchmarking environmental impacts and is done here to provide perspective on the magnitude of identified impacts. For waste management, waste generation rates were compared with the capacities of waste management facilities. Impacts within each resource area were analyzed consistently; that is, the impact values were estimated using a consistent set of input variables and computations. Moreover, calculations in all resource areas used accepted protocols and up-to-date models.

Baseline conditions at the four sites (Los Alamos National Laboratory [LANL], Sandia National Laboratories/New Mexico [SNL/NM], Nevada Test Site [NTS], and Argonne National Laboratory-West [ANL-W]) assessed in this EIS include present actions at each site. The No Action Alternative was used as the basis for the comparison of impacts that would occur under implementation of the other alternatives.

F.1 LAND RESOURCES

F.1.1 Land Use

F.1.1.1 Description of Affected Resources and Region of Influence

Land use includes the land on and adjacent to each candidate site, the physical features that influence current or proposed uses, pertinent land use plans and regulations, and land ownership and availability. The region of influence for land use varies due to the extent of land ownership, adjacent land use patterns and trends, and other geographic or safety considerations, but generally includes the site and areas immediately adjacent to the site.

F.1.1.2 Description of Impact Assessment

The amount of land disturbed and conformity with existing land use were considered in order to evaluate impacts at each candidate site from construction and operation (see **Table F–1**). Both factors were considered for each of the action alternatives. However, since new construction would not take place under the No Action Alternative, only conformity with existing land use was evaluated for this alternative. Land-use impacts could vary considerably from site to site, depending on the extent of new construction and where it would take place (i.e., on undeveloped land or within a previously disturbed area).

Table F–1 Impact Assessment Protocol for Land Resources

	Required Data		
Resource	***Affected Environment***	***Alternative***	***Measure of Impact***
Land area used	Site acreage	Facility location and acreage requirement	Acreage converted to project use
Compatibility with existing or future facility land use	Existing facility land use configurations	Location of facility on the site; expected modifications of facility activities and missions to accommodate the alternatives	Incompatibility with existing or future facility land use
Visual resources	Current Visual Resource Management classification	Location of facility on the site; facility dimensions and appearance	Change in Visual Resource Management classification

F.1.2 Visual Resources

F.1.2.1 Description of Affected Resources and Region of Influence

Visual resources are the natural and human-created features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape; however, they exert varying degrees of influence. The stronger the influence exerted by these elements in a landscape, the more interesting the landscape. The region of influence for visual resources includes the geographic area from which the candidate facilities may be seen.

F.1.2.2 Description of Impact Assessment

Impacts to visual resources from construction and operation of the proposed action at each site may be determined by evaluating whether the Bureau of Land Management Visual Resource Management classifications of the candidate sites would change as a result of the proposed action (DOI 1986) (see Table F–1). Existing classifications were derived from an inventory of scenic qualities, sensitivity levels, and distance zones for particular areas. For those alternatives involving existing facilities at candidate U.S. Department of Energy (DOE) sites, alterations to visual features may be readily evaluated and the impact on the current Visual Resource Management classification determined. In order to determine the range of potential visual effects from new facilities, the analysis considered potential impacts from construction and operation in light of the aesthetic quality of surrounding areas, as well as the visibility of the proposed action from public vantage points.

F.2 SITE INFRASTRUCTURE

F.2.1 Description of Affected Resources and Region of Influence

Site infrastructure includes the physical resources required to support the construction and operation of the candidate facilities. It includes the capacities of onsite road and rail transportation networks; electric power and electrical load capacities; natural gas, coal, and/or liquid fuel (e.g., gasoline, diesel fuel, propane) capacities; and water supply system capacities.

The region of influence is generally limited to the boundaries of DOE sites. However, should infrastructure requirements exceed site capacities, the region of influence would be expanded (for analysis) to include the sources of additional supply. For example, if electrical demand (with added facilities) exceeded site availability, then the region of influence would be expanded to include the likely source of additional power (i.e., the power pool currently supplying the site).

F.2.2 Description of Impact Assessment

In general, infrastructure impacts were assessed by evaluating the requirements of each alternative against the site capacities. An impact assessment was made for each resource (i.e., transportation, electricity, fuel, and water) for the various alternatives (see **Table F–2**). Local transportation impacts were addressed qualitatively, as transportation infrastructure requirements under the proposed action were considered negligible. Tables reflecting site availability and infrastructure requirements were developed for each alternative. Data for these tables were obtained from reports describing the existing infrastructure at the sites, and from the data reports for each alternative. If necessary, design mitigation considerations conducive to reduction of the infrastructure demand were also identified.

Table F–2 Impact Assessment Protocol for Infrastructure

	Required Data		
Resource	***Affected Environment***	***Alternative***	***Measure of Impact***
Transportation - Roads (kilometers) - Railroads (kilometers)	Site capacity and current usage	Facility requirements	Additional requirement (with added facilities) exceeding site capacity
Electricity - Energy consumption (megawatt-hours per year) - Peak load (megawatts)	Site capacity and current usage	Facility requirements	Additional requirement (with added facilities) exceeding site capacity
Fuel - Natural gas (cubic meters per year) - Liquid fuel (liters per year) - Coal (tons per year)	Site capacity and current usage	Facility requirements	Additional requirement (with added facilities) exceeding site capacity
Water (liters per year)	Site capacity and current usage	Facility requirements	Additional requirement (with added facilities) exceeding site capacity

Any projected demand for infrastructure resources exceeding site availability can be regarded as an indicator of environmental impact. Whenever projected demand approaches or exceeds capacity, further analysis for that resource is warranted. Often, design changes can mitigate the impact of additional demand for a given resource. For example, substituting fuel oil for natural gas (or vice versa) for heating or industrial processes can be accomplished at little cost during the design of a facility, provided the potential for impact is identified early. Similarly, a dramatic spike or surge in peak demand for electricity can sometimes be mitigated by changes to operational procedures or parameters.

F.3 AIR QUALITY

F.3.1 Description of Affected Resources and Region of Influence

Air pollution refers to the introduction, directly or indirectly, of any substance into the air that could:

- endanger human health,
- harm living resources and ecosystems,
- damage material property, or
- impair or interfere with the comfortable enjoyment of life and other legitimate uses of the environment.

For the purpose of this TA-18 Relocation EIS, only outdoor air pollutants were addressed. They may be in the form of solid particles, liquid droplets, gases, or a combination of these forms. Generally, they can be categorized as primary pollutants (those emitted directly from identifiable sources) and secondary pollutants (those produced in the air by interaction between two or more primary pollutants, or by reaction with normal atmospheric constituents that may be influenced by sunlight). Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Thus, air quality is affected by air pollutant emission characteristics, meteorology, and topography.

Ambient air quality in a given location can be described by comparing the concentrations of various pollutants in the atmosphere with the appropriate standards. Ambient air quality standards have been established by Federal and state agencies, allowing an adequate margin of safety for the protection of public health and welfare from the adverse effects of pollutants in the ambient air. Pollutant concentrations higher than the corresponding standards are considered unhealthy; those below such standards, acceptable.

The pollutants of concern are primarily those for which Federal and state ambient air quality standards have been established, including criteria air pollutants, hazardous air pollutants, and other toxic air compounds. Criteria air pollutants are those listed in 40 CFR Part 50, "National Primary and Secondary Ambient Air Quality Standards." Hazardous air pollutants and other toxic compounds are those listed in Title I of the Clean Air Act, as amended (40 U.S.C. 7401 et seq.), those regulated by the National Emissions Standards for Hazardous Air Pollutants (40 CFR 61), and those that have been proposed or adopted for regulation by the applicable state, or are listed in state guidelines. States may set ambient standards that are more stringent than the national ambient air quality standards. The more stringent of the state or Federal standards for each site is shown in this document. Also of concern are air pollutant emissions that may contribute to the depletion of stratospheric ozone or global warming.

Areas with air quality better than the National Ambient Air Quality Standards (NAAQS) for criteria air pollutants are designated as being in attainment, while areas with air quality worse than the NAAQS for such pollutants are designated as nonattainment. Areas may be designated as unclassified when sufficient data for attainment status designation are lacking. Attainment status designations are assigned by county, metropolitan statistical area, consolidated metropolitan statistical area, or portions thereof, or air quality control regions. Air quality control regions designated by the U.S. Environmental Protection Agency (EPA) are listed in 40 CFR Part 81, "Designation of Areas for Air Quality Planning Purposes." LANL, SNL/NM, NTS, and ANL-W are all located in attainment areas (40 CFR Sections 81.332, 81.329, and 81.313).

For locations that are in an attainment area for criteria air pollutants, Prevention of Significant Deterioration regulations limit pollutant emissions from new or modified sources and establish allowable increments of pollutant concentrations. Three Prevention of Significant Deterioration classifications are specified, with the criteria established, in the Clean Air Act. Class I areas include national wilderness areas, memorial parks larger than 2,020 hectares (5,000 acres), national parks larger than 2,430 hectares (6,000 acres), and areas that have been redesignated as Class I. Class II areas are all areas not designated as Class I. No Class III areas have been designated (42 U.S.C. 7472, Title I, Section 162).

LANL, SNL/NM, NTS, and ANL-W are all in Class II areas. However, LANL is adjacent to the Bandelier National Monument and Wilderness Area Class I area (DOE 1999a). SNL/NM is 80 kilometers (50 miles) from Bandelier National Monument and Wilderness Area (DOE 1999b). NTS is 208 kilometers (130 miles) from the Grand Canyon National Park Class I area, and 169 kilometers (105 miles) from Sequoia National Park Class I area (DOE 1996). ANL-W is 68 kilometers (42 miles) from the Craters of the Moon Wilderness Area Class I area (DOE 2000b).

The region of influence for air quality encompasses an area surrounding a candidate site that is potentially affected by air pollutant emissions caused by the alternatives. The air quality impact area normally evaluated is the area in which concentrations of criteria pollutants would increase more than a significant amount in a Class II area (i.e., on the basis of averaging period and pollutant: 1 microgram per cubic meter for the annual average for sulfur dioxide, nitrogen dioxide and particulate matter less than or equal to 10 microns in aerodynamic diameter (PM_{10}), 5 micrograms per cubic meter for the 24 hour average for sulfur dioxide and PM_{10}, 500 micrograms per cubic meters for the 8 hour average for carbon monoxide, 25 micrograms per cubic meter for the 3 hour average for sulfur dioxide, and 2,000 micrograms for the 1 hour average for carbon monoxide [40 CFR Section 51.165]). Generally, this covers a few kilometers downwind from the source. Further, for sources within 100 kilometers (60 miles) of a Class I area, the air quality impact area evaluated would include the Class I area if the increase in concentration were greater than 1 microgram per cubic meter (24-hour average). The area of the region of influence depends on emission source characteristics, pollutant types, emission rates, and meteorological and topographical conditions. For the purpose of this analysis, where most of the candidate sites are large, impacts were evaluated at the site boundary and roads within the sites to which the public has access, plus any additional area in which contributions to pollutant concentrations are expected to exceed significance levels.

Baseline air quality is typically described in terms of pollutant concentrations modeled for existing sources at each candidate site and background air pollutant concentrations measured near the sites. For this analysis, concentrations for existing sources were obtained from existing source documents such as the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (DOE 1999a), *Sandia National Laboratories/New Mexico Final Site-Wide Environmental Impact Statement* (DOE 1999b), *Idaho High-Level Waste and Facilities Disposition Draft Environmental Impact Statement* (DOE 1999c) and *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (DOE 2000a) and from modeling of concentrations using recent emissions inventories and the Industrial Source Complex (ISCST3) model (EPA 1995, EPA 2000).

F.3.2 Description of Impact Assessment

Potential air quality impacts of pollutant emissions from construction and normal operations were evaluated for each alternative. This assessment included a comparison of pollutant concentrations from each alternative with applicable Federal and state ambient air quality standards (see **Table F–3**). If both Federal and state standards exist for a given pollutant and averaging period, compliance was evaluated using the more stringent standard. Operational air pollutant emissions data for each alternative were based on conservative engineering analyses.

For each alternative, contributions to offsite air pollutant concentrations were modeled on the basis of guidance presented in EPA's "Guidelines on Air Quality Models" (40 CFR Part 51, Appendix W). The EPA-recommended model ISCST3 (EPA 1995), was selected as an appropriate model to perform the air dispersion modeling because it is designed to support the EPA regulatory modeling program and predicts conservative worst-case impacts.

The modeling analysis incorporated conservative assumptions, which tend to overestimate pollutant concentrations. The maximum modeled concentration for each pollutant and averaging time was selected for comparison with the applicable standard. The concentrations evaluated were the maximum occurring at or beyond the site boundary and at a public access road, or other publicly accessible area within the site. Available monitoring data, which reflect both onsite and offsite sources, were also taken into consideration. Concentrations of the criteria air pollutants were presented for each alternative. Concentrations of hazardous and toxic air pollutants were evaluated in the public and occupational health effects analysis. At least one year of representative hourly meteorological data was used for each site.

Table F–3 Impact Assessment Protocol for Air Quality

	Required Data		
Resource	***Affected Environment***	***Alternative***	***Measure of Impact***
Criteria air pollutants and other regulated pollutants [a]	Measured and modeled ambient concentrations (micrograms per cubic meter) from existing sources at site	Emission rate (kilograms per year) of air pollutants from facility; source characteristics (e.g., stack height and diameter, exit temperature and velocity)	Concentration of alternative and total site concentration of each pollutant at or beyond site boundary, or within boundary on public road compared to applicable standard
Toxic and hazardous air pollutants [b]	Measured and modeled ambient concentrations (micrograms per cubic meter) from existing sources at site	Emission rate (kilograms per year) of pollutants from facility; source characteristics (e.g., stack height and diameter, exit temperature and velocity)	Concentration of alternative and total site concentration of each pollutant at or beyond site boundary, or within boundary on public road used to calculate hazard quotient or cancer risk

[a] Carbon monoxide; hydrogen fluoride; lead; nitrogen oxides; ozone; particulate matter with an aerodynamic diameter less than or equal to 10 microns; sulfur dioxide; total suspended particulates.

[b] Clean Air Act, Section 112, hazardous air pollutant; pollutants regulated under the National Emissions Standard for Hazardous Air Pollutants; and other state-regulated pollutants.

Ozone is typically formed as a secondary pollutant in the ambient air (troposphere). It is formed in the presence of sunlight from the mixing of primary pollutants, such as nitrogen oxides, and volatile organic compounds that emanate from vehicular (mobile), natural, and other stationary sources. Ozone is not emitted directly as a pollutant from the candidate sites. Although ozone may be regarded as a regional issue, specific ozone precursors, notably nitrogen dioxide and volatile organic compounds, were analyzed as applicable to the alternatives under consideration.

The Clean Air Act, as amended, requires that Federal actions conform to the host state's "state implementation plan." A state implementation plan provides for the implementation, maintenance, and enforcement of NAAQS for the six criteria pollutants: sulfur dioxide, particulate matter with an aerodynamic diameter less than or equal to 10 microns, carbon monoxide, ozone, nitrogen dioxide, and lead. Its purpose is to eliminate or reduce the severity and number of violations of NAAQS and to expedite the attainment of these standards. No department, agency, or instrumentality of the Federal Government shall engage in or support in any way (i.e., provide financial assistance for, license or permit, or approve) any activity that does not conform to an applicable implementation plan. The final rule for "Determining Conformity of General Federal Actions to State or Federal Implementation Plans" (58 FR 63214) took effect on January 31, 1994. LANL, SNL/NM, NTS, and ANL-W are within areas currently designated as attainment for criteria air pollutants, except that SNL/NM is in a maintenance area for carbon monoxide. Therefore, the alternatives being considered at these sites are not affected by the provisions of the conformity rule, except at SNL/NM. If carbon monoxide emissions for the alternative at SNL/NM are below the applicability threshold of 100 tons/year, a conformity determination is not required (40 CFR 51.853).

Emissions of potential stratospheric ozone-depleting compounds such as chlorofluorocarbons were not evaluated, as no emissions of these pollutants were identified in the conceptual engineering design reports.

F.4 NOISE

F.4.1 Description of Affected Resources and Region of Influence

Sound results from the compression and expansion of air or some other medium when an impulse is transmitted through it. Sound requires a source of energy and a medium for transmitting the sound wave. Propagation of sound is affected by various factors, including meteorology, topography, and barriers. Noise is undesirable sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities (e.g., hearing, sleep), damage hearing, or diminish the quality of the environment.

Sound-level measurements used to evaluate the effects of nonimpulsive sound on humans are compensated by an A-weighting scale that accounts for the hearing response characteristics (i.e., frequency) of the human ear. Sound levels are expressed in decibels (dB), or in the case of A-weighted measurements, decibels A-weighted (dBA). EPA has developed noise-level guidelines for different land use classifications. Some states and localities have established noise control regulations or zoning ordinances that specify acceptable noise levels by land use category.

Noise from facility operations and associated traffic could affect human and animal populations. The region of influence for each candidate site includes the site, nearby offsite areas, and transportation corridors where proposed activities might increase noise levels. Transportation corridors most likely to experience increased noise levels are those roads within a few miles of the site boundary that carry most of the site's employee and shipping traffic.

Sound-level data representative of site environs were obtained from existing reports. The acoustic environment was further described in terms of existing noise sources for each candidate site.

F.4.2 Description of Impact Assessment

Noise impacts associated with the alternatives may result from construction and operation of facilities and from increased traffic (see **Table F–4**). Impacts from facility construction and operation were assessed according to the types of noise sources and the locations of the candidate facilities relative to the site boundary. Potential noise impacts from traffic were based on the likely increase in traffic volume. Possible impacts to wildlife were evaluated based on the possibility of sudden loud noises occurring during facility construction or modification and operation.

Table F–4 Impact Assessment Protocol for Noise

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Noise	Identification of sensitive offsite receptors (e.g., nearby residences); description of sound levels in the vicinity of the site	Description of major construction, modification, and operational noise sources; shipment and workforce traffic estimates	Increase in day/night average sound level at sensitive receptors

F.5 GEOLOGY AND SOILS

F.5.1 Description of Affected Resources and Region of Influence

Geologic resources include consolidated and unconsolidated earth materials, including mineral assets such as ore and aggregate materials, and fossil fuels such as coal, oil, and natural gas. Geologic conditions include hazards such as earthquakes, faults, volcanoes, landslides, sinkholes and other conditions leading to land subsidence, and unstable soils. Soil resources include the loose surface materials of the earth in which plants grow, usually consisting of mineral particles from disintegrating rock, organic matter, and soluble salts. Prime farmland, as defined in 7 CFR Part 657.5, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water).

Geology and soils were considered with respect to those portions of the resource that could be affected by the alternatives, as well as natural conditions that could affect the alternative. Thus, the region of influence for geology and soils includes the project site and nearby offsite areas subject to disturbance by facility construction and operation under the alternatives, including those areas beneath existing or new facilities that would remain inaccessible for the life of the facilities. The region of influence also encompasses those geology and soil conditions that could affect the integrity and safety of the facilities include large-scale geologic hazards (e.g., earthquakes, volcanic activity, landslides, and land subsidence) and local hazards associated with the site-specific attributes of the soil and bedrock beneath site facilities.

F.5.2 Description of Impact Assessment

Facility construction and operations for the relocation alternatives were considered from the perspective of impacts on specific geologic resources and soil attributes. Construction and facility modification activities were the focus of the impacts assessment for geologic and soil resources; hence, key factors in the analysis were the land area to be disturbed during construction and occupied during operations (see **Table F–5**). The main objective was avoidance of the siting of new or modified facilities over unstable soils (i.e., soils prone to subsidence, liquefaction, shrink-swell, or erosion).

Table F–5 Impact Assessment Protocol for Geology and Soils

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Geologic hazards	Presence of geologic hazards within the region of influence	Location of facility on the site	Potential for damage to facility
Valuable mineral and energy resources	Presence of any valuable mineral or energy resources within the region of influence	Location of facility on the site	Potential to destroy or render resources inaccessible
Prime farmland soils	Presence of prime farmland soils within the region of influence	Location of facility on the site	Conversion of prime farmland soils to nonagricultural use

The geology and soils impact analysis (see Table F–5) also considered the risks to the existing and new facilities of large-scale geologic hazards such as faulting and earthquakes, lava extrusions and other volcanic activity, landslides, and sinkholes (i.e., conditions that tend to affect broad expanses of land). This element of the assessment included collection of site-specific information on the potential for impacts on site facilities from local and large-scale geologic conditions. Historical seismicity within a given radius of each facility site was reviewed as a means of assessing the potential for future earthquake activity. As used in this EIS, earthquakes are described in terms of several parameters as presented in **Table F–6**. This included identification of maximum considered earthquake ground motion at each site as reflected in the International Building Code (ICC 2000) and in any site-specific studies. In general, the facility hazard assessment was based on the presence of any identified hazard and the distance of the facilities from it.

Table F–6 The Modified Mercalli Intensity Scale of 1931, with Generalized Correlations to Magnitude, Earthquake Classification, and Peak Ground Acceleration

Modified Mercalli Intensity [a]	*Observed Effects of Earthquake*	*Approximate Magnitude* [b]	*Class*	*Peak Ground Acceleration* [c] *(g)*
I	Usually not felt except by a very few under very favorable conditions.	Less than 3	Less than 2.5 - Micro	Less than 0.0017
II	Felt only by a few persons at rest, especially on the upper floors of buildings.	3 to 3.9	Minor	0.0017 to 0.014
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck.			
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy object striking building. Standing motor cars rock noticeably.	4 to 4.9	Light	0.014 to 0.039
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.			0.039 to 0.092
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.	5 to 5.9	Moderate	0.092 to 0.18
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.	6 to 6.9	Strong	0.18 to 0.34
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.	7 to 7.9	Major	0.34 to 0.65
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.			0.65 to 1.24
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.			1.24 and higher
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.	8 and higher	Great	
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.			

[a] Intensity is a unitless expression of observed effects from earthquake-produced ground shaking. Effects may vary greatly between locations based on earthquake magnitude, distance from the earthquake, and local subsurface geology. The descriptions given are abbreviated from the Modified Mercalli Intensity Scale of 1931.

[b] Magnitude is an exponential function of seismic wave amplitude, related to the energy released. There are several "magnitude" scales in common use including local "Richter" magnitude, body-wave magnitude, surface wave magnitude, and moment magnitude. Each has applicability for measuring particular aspects of seismic signals and may be considered equivalent within each scale's respective range of validity.

[c] Acceleration is expressed as a percent relative to the earth's gravitational acceleration (g) (i.e., g = 980 centimeters per second squared). Given values are correlated to Modified Mercalli Intensity based on measurements of California earthquakes only (Wald et al. 1999).

Source: Compiled from Wald et al. 1999, USGS 2000a, USGS 2000b.

An evaluation was also performed to determine if construction or operation of relocated facilities at a specific site could destroy, or preclude the use of, valuable mineral or energy resources.

Pursuant to the Farmland Protection Policy Act (7 U.S.C. 4201 et seq.), and the regulations (7 CFR 658) promulgated as a result thereof, the presence of prime farmland was also evaluated. This act requires agencies to make Farmland Protection Policy Act evaluations part of the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 et seq.) process, the main purpose being to reduce the conversion of farmland to nonagricultural uses by Federal projects and programs. Potential prime farmlands not acquired prior to June 22, 1982, the effective date of the Farmland Protection Policy Act, are exempt from its provisions as are lands acquired or used by a Federal agency for national defense purposes.

F.6 WATER RESOURCES

F.6.1 Description of Affected Resources and Region of Influence

Water resources are the surface and subsurface waters that are suitable for human consumption, aquatic or wildlife propagation, agricultural purposes, irrigation, or industrial/commercial purposes. The region of influence used for water resources encompasses those site and adjacent surface water and groundwater systems which could be impacted by water withdrawals, effluent discharges, and spills or stormwater runoff associated with facility construction and operational activities under the relocation alternatives.

F.6.2 Description of Impact Assessment

Determination of the impacts of the relocation alternatives on water resources consisted of a comparison of site-generated data and professional estimates regarding water use and effluent discharge with applicable regulatory standards, design parameters and standards commonly used in the water and wastewater engineering fields, and recognized measures of environmental impact.

Certain assumptions were made to facilitate the impacts assessment: (1) that all water supply (production and treatment) and effluent treatment facilities would be approved by the appropriate permitting authority; (2) that the effluent treatment facilities would meet the effluent limitations imposed by the respective National Pollutant Discharge Elimination System permits; and (3) that any stormwater runoff from construction and operation activities would be handled in accordance with the regulations of the appropriate permitting authority. It was also assumed that, during construction, sediment fencing or other erosion control devices would be used to mitigate short-term adverse impacts from sedimentation, and that, as appropriate, stormwater holding ponds would be constructed to lessen the impacts of runoff on surface water quality.

F.6.2.1 Water Use and Availability

This analysis involved the review of engineering estimates of expected surface water and/or groundwater use and effluent discharge associated with facility construction and operation activities for each alternative, and the impacts on local and regional water availability in terms of quantity and quality. Impacts on water use and availability were generally assessed by determining changes in the volume of current water usage and effluent discharge as a result of the proposed activities. For facilities intending to use surface water, effluent discharges back to surface waters were included in the evaluation to determine net usage. The impact of discharging withdrawn groundwater to surface waters or back to the subsurface was also considered, as appropriate. The determination of impacts on water use and availability are summarized in **Table F–7**.

Table F–7 Impact Assessment Protocol for Water Use and Availability

Resource	Required Data		Measure of Impact
	Affected Environment	Facility Design	
Surface water availability	Surface waters near the facilities, including average flow and current usage	Volume of withdrawals from, and discharges to, surface waters	Changes in availability to local/ downstream users of water for human consumption, irrigation, or animal feeding
Groundwater availability	Groundwater near the facilities, including existing water rights for major water users and current usage	Volume of withdrawals from, and discharges to, groundwater	Changes in availability of groundwater for human consumption, irrigation, or animal feeding

If the determination of impacts reflected an increase in water use or effluent discharge, then an evaluation of the design capacity of the water supply production and treatment facilities and the effluent treatment facilities, respectively, was made to determine whether the design capacities would be exceeded by the additional flows. If the combined flow (i.e., the existing flow plus those from the proposed activities), was less than the design capacity of the water supply systems and effluent treatment plants, then it was assumed that there would be no impact on water availability for local users, or on receiving surface waters or groundwater from effluent discharges. Further, a separate analysis (see Section F.6.2.2) was performed as necessary to determine the potential for effluent discharge impacts on ambient surface water or groundwater quality based on the results of the effluent treatment capacity analysis.

Because water withdrawals and effluent discharges from the site facilities were generally found not to exceed the design capacity of existing water supply systems or effluent treatment facilities, additional analyses were not performed.

F.6.2.2 Water Quality

The water quality impact assessment analyzed how effluent discharges to surface water, as well as discharges reaching groundwater, from the facilities under each alternative would directly affect current water quality. The determination of the impacts of the alternatives is summarized in **Table F–8** and consisted of a comparison of the projected effluent quality with relevant regulatory standards and implementing regulations under the Clean Water Act (33 U.S.C. 1251 et seq.), Safe Drinking Water Act (42 U.S.C. 300 (f) et seq.), state laws, and existing site permit conditions. Separate analyses were conducted for surface water and groundwater impacts.

Table F–8 Impact Assessment Protocol for Water Quality

Resource	Required Data		Measure of Impact
	Affected Environment	Facility Design	
Surface water quality	Surface waters near the facilities in terms of stream classifications and changes in water quality	Expected contaminants and contaminant concentrations in discharges to surface waters	Exceedance of relevant surface water quality criteria or standards established in accordance with the Clean Water Act or state regulations and existing permits
Groundwater quality	Groundwater near the facilities in terms of classification, presence of designated sole source aquifers, and changes in quality of groundwater	Expected contaminants and contaminant concentrations in discharges that could reach groundwater	Contaminant concentrations in groundwater exceeding relevant standards or criteria established in accordance with the Safe Drinking Water Act or state regulations and existing permits

Surface Water Quality—The evaluation of surface water quality impacts focused on the quality and quantity of any effluents (including stormwater) to be discharged and the quality of the receiving stream upstream and downstream from the discharges. The evaluation of effluent quality featured review of the expected parameters, such as the design average and maximum flows, as well as the effluent parameters reflected in the existing or expected National Pollutant Discharge Elimination System or applicable state discharge permit. Those parameters include total suspended solids, metals, organic and inorganic chemicals, and any other constituents that could affect the local environment. Any proposed water quality management practices were reviewed to ensure that any applicable permit limitations and conditions would be met. Factors that currently degrade water quality were also identified.

During facility construction, ground disturbing activities could impact surface waters through increased runoff and sedimentation. Such impacts relate to the amount of land disturbed, the type of soil at the site, the topography, and weather conditions. They would be minimized by application of standard management practices for stormwater and erosion control (e.g., sediment fences, mulching disturbed areas).

During operations, surface waters could be affected by increased runoff from parking lots, buildings, or other cleared areas. Stormwater from these areas could be contaminated with materials deposited by airborne pollutants, automobile exhaust and residues, materials handling, and process effluents. Impacts of stormwater discharges could be highly specific, and mitigation would depend on management practices, the design of holding facilities, the topography, and adjacent land use. Data from existing water quality databases were compared with expected flows from the facilities to determine the relative impacts on surface waters.

Groundwater Quality—Potential groundwater quality impacts associated with any effluent discharges during facility construction and operation activities were examined. Engineering estimates of contaminant concentrations were weighed against applicable Federal and state groundwater quality standards, effluent limitations, and drinking water standards to determine the impacts of each alternative. Also evaluated were the consequences of groundwater use and effluent discharge on other site groundwater conditions.

F.6.2.3 Waterways and Floodplains

The locations of waterways (e.g., ponds, lakes, streams) and the 100- and 500-year floodplains were identified from maps and other existing documents to assess the potential for impacts from facility construction and operation activities, including direct effects on hydrologic characteristics or secondary effects such as sedimentation (see Surface Water Quality in Section F.6.2.2.). All activities would be conducted to avoid delineated floodplains and to ensure compliance with Executive Order 11988, *Floodplain Management*. However, for any facilities proposed for location in a floodplain, a floodplain assessment would be prepared.

F.7 ECOLOGICAL RESOURCES

F.7.1 Description of Affected Resources and Region of Influence

Ecological resources include terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. The region of influence for the ecological resource analysis encompassed the site and adjacent areas potentially disturbed by construction and operation of the candidate facilities.

Terrestrial resources are defined as those plant and animal species and communities that are most closely associated with the land; for aquatic resources, a water environment. Wetlands are defined by the U.S. Army Corps of Engineers and EPA as "… those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR Section 328.3).

Endangered species are defined under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.) as those in danger of extinction throughout all or a large portion of their range. Threatened species are defined as those species likely to become endangered within the foreseeable future. The U.S. Fish and Wildlife Service and the National Marine Fisheries Service propose species to be added to the lists of threatened and endangered species. They also maintain a list of "candidate" species for which they have evidence that listing may be warranted, but for which listing is currently precluded by the need to list species more in need of Endangered Species Act protection. Candidate species do not receive legal protection under the Endangered Species Act, but should be considered in project planning in case they are listed in the future. Critical habitat for threatened and endangered species is designated by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service. Critical habitat is defined as specific areas that contain physical and biological features essential to the conservation of species and that may require special management consideration or protection. States may also designate species as endangered, threatened, sensitive protected, in need of management, of concern, monitored, or species of special concern.

F.7.2 Description of Impact Assessment

Impacts to ecological resources may occur as a result of land disturbance, water use, air and water emissions, human activity, and noise associated with project implementation (see **Table F–9**). Each of these factors was considered when evaluating potential impacts from the proposed action. For those alternatives involving construction of new facilities, direct impacts to ecological resources was based on the acreage of land disturbed by construction. Indirect impacts from factors such as human disturbance and noise were evaluated qualitatively. Indirect impacts to ecological resources, including wetlands, from construction due to erosion were evaluated qualitatively, recognizing that standard erosion and sediment control practices would be followed. Impacts to terrestrial and aquatic ecosystems and wetlands from water use and air and water emissions were evaluated based on the results of the analyses conducted for air quality and water resources. The determination of impacts to threatened and endangered species was based on similar factors as noted above for terrestrial resources, wetlands, and aquatic resources.

Table F–9 Impact Assessment Protocol for Ecological Resources

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Terrestrial resources	Vegetation and wildlife within vicinity of facilities	Facility location and acreage requirement, air and water emissions, and noise	Loss or disturbance to terrestrial habitat; emissions and noise values above levels shown to cause impacts to terrestrial resources
Wetlands	Wetlands within vicinity of facilities	Facility location and acreage requirement, air and water emissions, and wastewater discharge quantity and location	Loss or disturbance to wetlands; discharge to wetlands
Aquatic resources	Aquatic resources within vicinity of facilities	Facility air and water emissions, water source and quantity, and wastewater discharge location and quantity	Discharges above levels shown to cause impacts to aquatic resources; changes in water withdrawals and discharges
Threatened and endangered species	Threatened and endangered species and critical habitats within vicinity of facilities	Facility location and acreage requirement, air and water emissions, noise, water source and quantity, and wastewater discharge location and quantity	Measures similar to those noted above for terrestrial and aquatic resources

F.8 Cultural and Paleontological Resources

F.8.1 Description of Affected Resources and Region of Influence

Cultural resources are the indications of human occupation and use of the landscape as defined and protected by a series of Federal laws, regulations, and guidelines. For this TA-18 Relocation EIS, potential impacts were assessed separately for each of the three general categories of cultural resources: prehistoric, historic, and Native American. Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age, and may be sources of information on ancient environments and the evolutionary development of plants and animals. Although not governed by the same historic preservation laws as cultural resources, they could be affected by the proposed action in much the same manner.

Prehistoric resources are physical remains of human activities that predate written records; they generally consist of artifacts that may alone or collectively yield otherwise inaccessible information about the past. Historic resources consist of physical remains that postdate the emergence of written records; in the United States, they are architectural structures or districts, archaeological objects, and archaeological features dating from 1492 and later. Ordinarily, sites less than 50 years old are not considered historic, but exceptions can be made for such properties if they are of particular importance, such as structures associated with Cold War themes. Native American resources are sites, areas, and materials important to Native Americans for religious or heritage reasons. Such resources may include geographical features, plants, animals, cemeteries, battlefields, trails, and environmental features. The region of influence for the cultural and paleontological resource analysis encompassed the site and areas adjacent to the site that are potentially disturbed by construction and operation of the candidate facilities.

F.8.2 Description of Impact Assessment

The analysis of impacts to cultural and paleontological resources addressed potential direct and indirect impacts at each candidate site from construction and operation (see **Table F–10**). Direct impacts include those resulting from groundbreaking activities associated with new construction and possibly building modifications. Indirect impacts include those associated with reduced access to a resource site, as well as impacts associated with increased stormwater runoff, increased traffic, and visitation to sensitive areas.

Table F–10 Impact Assessment Protocol for Cultural and Paleontological Resources

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Prehistoric resources	Prehistoric resources within the vicinity of facilities	Facility location and acreage requirement	Potential for loss, isolation, or alteration of the character of prehistoric resources; introduction of visual, audible, or atmospheric elements out of character
Historic resources	Historic resources within the vicinity of facilities	Facility location and acreage requirement	Potential for loss, isolation, or alteration of the character of historic resources; introduction of visual, audible, or atmospheric elements out of character
Native American resources	Native American resources within the vicinity of facilities	Facility location and acreage requirement	Potential for loss, isolation, or alteration of the character of Native American resources; introduction of visual, audible or atmospheric elements out of character
Paleontological resources	Paleontological resources within the vicinity of facilities	Facility location and acreage requirement	Potential for loss, isolation or alteration of paleontological resources

F.9 SOCIOECONOMICS

F.9.1 Description of Affected Resources and Region of Influence

Socioeconomic impacts are defined in terms of changes to the demographic and economic characteristics of a region. The number of jobs created by the proposed action could affect regional employment, income, and expenditures. Job creation is characterized by two types: (1) construction-related jobs, which are transient in nature and short in duration, and thus less likely to impact public services; and (2) operation-related jobs, which would last for the duration of the proposed project, and thus could create additional service requirements in the region of influence.

The region of influence for the socioeconomic environment represents a geographic area where site employees and their families reside, spend their income, and use their benefits, thereby affecting the economic conditions of the region. Site-specific regions of influence were identified as those counties in which approximately 90 percent or more of the site's workforce reside. This distribution reflects an existing residential preference for people currently employed at the sites and was used to estimate the distribution of workers associated with facility construction and operation under the relocation alternatives.

F.9.2 Description of Impact Assessment

For each site, data were compiled on the current socioeconomic conditions, including unemployment rates, economic area industrial and service sector activities, and the civilian labor force. The workforce requirements of each alternative were determined in order to measure their possible effect on these socioeconomic conditions. Although workforce requirements may be able to be filled by employees already working at DOE sites, it was assumed that new employees would be hired to ensure that the maximum impact was assessed. For each site, census statistics were also compiled on population, housing demand, and community services. U.S. Census Bureau population forecasts for the regions of influence were combined with overall projected workforce requirements for each of the alternatives being considered at each candidate site to determine the extent of impacts on housing demand and levels of community services (see **Table F–11**).

F.10 WASTE MANAGEMENT

F.10.1 Description of Affected Resources and Region of Influence

Depending on the alternative, construction and operation of the candidate facilities would generate several types of waste. Such wastes may include the following:

- Low-level radioactive: Waste that contains radioactivity and is not classified as high-level radioactive waste, transuranic waste, or spent nuclear fuel, or the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level radioactive waste, provided the transuranic concentration is less than 100 nanocuries per gram of waste.

- Mixed low-level radioactive: Low-level radioactive waste that also contains hazardous components regulated under the Resource Conservation and Recovery Act (42 U.S.C. 6901 et seq.).

Table F–11 Impact Assessment Protocol for Socioeconomics

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Regional Economic Characteristics			
Workforce requirements	Site workforce projections from DOE sites	Estimated construction and operating staff requirements and time frames	Workforce requirements added to sites' workforce projections
Region of influence civilian labor force	Labor force estimates	Estimated construction and operating staff requirements and time frames	Workforce requirements as a percentage of the civilian labor force
Employment	Latest available employment in counties surrounding sites	Estimated construction and operating staff requirements	Potential change in employment
Demographic Characteristics			
Population and demographics of race, ethnicity, and income	Latest available estimates by county from the U.S. Census Bureau	Estimated effect on population	Potential effects on population
Housing and Community Services			
Housing – percent of occupied housing units	Latest available ratios from the U.S. Census Bureau	Estimated housing unit requirements	Potential change in housing unit availability
Education - Total enrollment - Teacher-to-student ratio	Latest available information from the U.S. Department of Education	Estimated effect on enrollment and teacher-student ratio	Potential change in student enrollment Potential change in teacher-student ratio
Health care – number of hospital beds and physicians per 1,000 residents	Latest available rates from the U.S. Census Bureau	Estimated effect on ratio	Potential change in the availability of hospital beds/physicians-population ratio

- Hazardous: Under the Resource Conservation and Recovery Act, a waste that, because of its characteristics, may (1) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness, or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Hazardous wastes appear on special EPA lists or possess at least one of the following characteristics: ignitability, corrosivity, reactivity, or toxicity. This category does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act (42 U.S.C. 2011 et. seq).

- Nonhazardous: Discarded material including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities. This category does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act (42 U.S.C. 2011 et seq.).

The alternatives could have an impact on existing site facilities devoted to the treatment, storage, and disposal of these categories of waste. Waste management activities in support of the proposed action would be contingent on Records of Decision issued for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (Waste Management PEIS)* (DOE 1997). In the Record of Decision for hazardous waste, released on August 5, 1998 (63 FR 41810), DOE sites evaluated in this TA-18 Relocation EIS will continue to use offsite facilities for the treatment and disposal of major portions of their nonwastewater hazardous waste, (with the

Oak Ridge Reservation continuing to treat some of its nonwastewater hazardous waste in existing facilities where economically feasible). Based on the Record of Decision for low-level radioactive waste and mixed low-level radioactive waste issued on February 18, 2000 (65 FR 10061), minimal treatment of low-level radioactive waste will be performed at all sites, and to the extent practical, onsite disposal of low-level radioactive waste will continue. Hanford and the Nevada Test Site will be made available to all DOE sites for the disposal of low-level radioactive waste. Mixed low-level radioactive waste analyzed in the Waste Management PEIS will be treated at Hanford, the Idaho National Engineering and Environmental Laboratory, the Oak Ridge Reservation, and the Savannah River Site and will be disposed of at Hanford and the Nevada Test Site.

F.10.2 Description of Impact Assessment

Waste management impacts were assessed by comparing the projected waste stream volumes generated from the proposed activities at each candidate site with that site's waste management capacities and generation rates (see **Table F–12**). Only the impacts relative to the capacities of waste management facilities were considered; other environmental impacts of waste management facility operations (e.g., human health effects) are evaluated in other sections of this TA-18 Relocation EIS, or in other facility-specific or sitewide NEPA documents. Projected waste generation rates for the proposed activities were compared with site processing rates and capacities of those treatment, storage, and disposal facilities likely to be involved in managing the additional waste. The waste generation rates were provided by the sites' technical personnel. Potential impacts from waste generated as a result of site environmental restoration activities are not within the scope of this analysis.

Table F–12 Impact Assessment Protocol for Waste Management

Resource	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Waste management capacity - Low-level radioactive waste - Mixed low-level radioactive waste - Hazardous waste - Nonhazardous waste	Site generation rates (cubic meters per year) for each waste type Site management capacities (cubic meters) or rates (cubic meters per year) for potentially affected treatment, storage, and disposal facilities for each waste type	Generation rates (cubic meters per year) from facility operations for each waste type	Combination of facility waste generation volumes and other site generation volumes in comparison to the capacities of applicable waste management facilities

F.11 CUMULATIVE IMPACTS

Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR Section 1508.7). The cumulative impact analysis for this *TA-18 Relocation EIS* involved combining the impacts of the alternatives (including the No Action Alternative) with the impacts of other present and reasonably foreseeable activities in the regions of influence. The key resources are identified in **Table F–13**.

In general, cumulative impacts were determined by collectively considering the baseline affected environment (i.e., conditions attributable to present actions by DOE and other public and private entities), the proposed action (or no action), and other future actions. Quantifiable information was incorporated to the degree available. Factors were weighed against the appropriate impact indicators (e.g., site capacity or number of fatalities) to determine the potential for impact. For this cumulative impact assessment, it was conservatively assumed that all facilities would operate concurrently at the candidate DOE sites. The selected indicators of cumulative impacts evaluated in this TA-18 Relocation EIS are shown in **Table F–14**.

Table F–13 Key Resources and Associated Regions of Influence

Resources	***Region of Influence***
Resource use	The site
Air quality	The site, nearby offsite areas within local air quality control regions, where significant air quality impacts may occur, and Class I areas within 100 kilometers
Human health	The site, offsite areas within 80 kilometers (50 miles) of the site, and the transportation corridors between the sites where worker and general population radiation, radionuclide, and hazardous chemical exposures may occur
Waste management	The site
Transportation	Onsite and offsite highways used for material transport

Table F–14 Selected Indicators of Cumulative Impact

Category	***Indicator***
Resource use	- Workers required compared with existing workforce - Electricity use compared with site capacity - Water use compared with site capacity
Air quality	Criteria pollutant concentrations and comparisons with standards or guidelines
Human health	Public - Maximally exposed offsite individual dose - Offsite population dose - Fatalities Workers - Total dose - Fatalities
Waste	- Low-level radioactive waste generation rate compared with existing management capacities and generation rate - Mixed low-level radioactive waste generation rate compared with existing management capacities and generation rate - Hazardous waste generation rate compared with existing management capacities and generation rate - Nonhazardous waste generation rate compared with existing management capacities and generation rate
Transportation	Radiation exposures - Public - Transportation workers - Fatalities Traffic fatalities

The analysis focused on the potential for cumulative impacts at each candidate site from DOE actions under detailed consideration at the time of this TA-18 Relocation EIS, as well as cumulative impacts associated with transportation. The following sitewide NEPA documents were used to establish baseline conditions upon which incremental cumulative impacts were assessed:

- *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (DOE 1999a);
- *Sandia National Laboratories/New Mexico Final Site-Wide Environmental Impact Statement* (DOE 1999b);
- *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 1996);
- *Idaho High-Level Waste and Facilities Disposition Environmental Impact Statement* (DOE 1999i).

The related programs included in the cumulative impact assessment for the potentially affected candidate sites are identified in **Table F–15**.

It is assumed that construction impacts would not be cumulative because construction is typically short in duration, and construction impacts are generally temporary. Decontamination and decommissioning of the candidate facilities was not addressed in the cumulative impact estimates. Given the uncertainty regarding the timing of decontamination and decommissioning, any impact estimate at this time would be highly speculative. A detailed evaluation of decontamination and decommissioning would be provided in follow-on NEPA documentation closer to the actual time of those actions.

Table F–15 Other Present and Reasonably Foreseeable Actions Considered in the Cumulative Impact Assessment

Activities	*LANL*	*SNL/NM*	*NTS*	*INEEL/ ANL-W*
Waste Management PEIS				X
Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management				X
Foreign Research Reactor Spent Nuclear Fuel Management				X
Nuclear Infrastructure PEIS				X
Advanced Mixed Waste Treatment Project				X
Treatment and Management of Sodium-Bonded Spent Nuclear Fuel				X
Atlas Relocation and Operation	X		X	
Sandia Underground Reactor Facility		X		
Microsystems and Engineering Sciences Applications Complex		X		
Idaho High-Level Waste and Facilities Disposition				X

F.12 References

DOE (U.S. Department of Energy), 1996, *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243, Nevada Operations Office, Las Vegas, Nevada, August.

DOE (U.S. Department of Energy), 1997, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-0200-F, Office of Environmental Management, Washington, DC, May.

DOE (U.S. Department of Energy), 1999a, *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, DOE/EIS-0238, Albuquerque Operations Office, Albuquerque, New Mexico, January.

DOE (U.S. Department of Energy), 1999b, *Sandia National Laboratories/New Mexico Final Site-Wide Environmental Impact Statement*, DOE/EIS-0281, Albuquerque Operations Office, Albuquerque, New Mexico, October.

DOE (U.S. Department of Energy), 1999c, *Idaho High-Level Waste and Facilities Disposition Draft Environmental Impact Statement,* DOE/EIS-0287D, Idaho Operations Office, Idaho Falls, Idaho, December.

DOE (U.S. Department of Energy), 2000a, *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel,* DOE/EIS-0306, Office of Nuclear Energy, Science and Technology, Washington, DC, July.

DOE (U.S. Department of Energy), 2000b, *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility*, DOE/EIS-0310, Office of Nuclear Energy, Science and Technology, Washington, DC, December.

DOI (U.S. Department of Interior), 1986, *Visual Resource Contrast Rating,* BLM Manual Handbook H-8431-1, Bureau of Land Management, Washington, DC, January 17.

EPA (U.S. Environmental Protection Agency), 1995, *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Vol. 1 - User Instructions*, EPA-454/B-95-003a, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September.

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ICC (International Code Council, Inc.), 2000, *International Building Code*, Falls Church, Virginia, March.

USGS (U.S. Geological Survey), 2000a, *National Seismic Hazard Mapping Project*, Frequently Asked Questions, Geologic Hazards Team, Golden, Colorado, March 1 (*available at www.geohazards.cr.usgs.gov/eq/html/faq.html*).

USGS (U.S. Geological Survey), 2000b, *General Earthquake Information*, National Earthquake Information Center, Geologic Hazards, March 21 (*available at http://neic.usgs.gov/neis/general/handouts/*).

Wald, D. J., Quitoriano, V., Heaton, T. H., and H. Kanamori, 1999, "Relationships Between Peak Ground Acceleration, Peak Ground Velocity and Modified Mercalli Intensity in California," *Earthquake Spectra*, Vol. 15 (3), pp. 557-564 (*available at http://www-socal.wr.usgs.gov/shake/pubs/regress/regress.html*).

APPENDIX G

Ecological Resources

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APPENDIX G
ECOLOGICAL RESOURCES

Table G–1 contains a listing of the scientific names of animal and plant species found in the text. Species are listed in alphabetical order by common name within each taxonomic group.

Table G–1 Scientific Names of Plant and Animal Species

Common Name	***Scientific Name***
Mammals	
Big free-tailed bat	*Nyctinomops macrotis*
Black bear	*Ursus americanus*
Black-tailed jackrabbit	*Lepus californicus*
Bobcat	*Lynx rufus*
Cliff chipmunk	*Eutamias dorsalis*
Cottontail rabbit	*Sylvilagus audubonii*
Coyote	*Canis latrans*
Deer mouse	*Peromyscus maniculatus*
Elk	*Cervus elaphus*
Fringed myotis	*Myotis thysanodes*
Goat Peak pika	*Ochotona princeps nigrescens*
Gray wolf	*Canis lupus*
Great Basin pocket mouse	*Perognathus parvus*
Gunnison's prairie dog	*Cynomys gunnisoni*
Kit fox	*Vulpes velox*
Long-eared myotis	*Myotis evotis*
Long-legged myotis	*Myotis volans*
Long-tailed pocket mouse	*Chaetodipus formosus*
Long-tailed vole	*Iklicrotus longicaudus*
Long-tailed weasel	*Mustela frenata*
Merriam's kangaroo rat	*Dipodomys merriami*
Merriam's shrew	*Sorex merriami*
Mountain lion	*Felis concolor*
Mule deer	*Odocoileus hemionus*
New Mexico jumping mouse	*Zapus hudsonius luteus*
Occult little brown bat	*Myotis lucifugus occultus*
Pale Townsend's big-eared bat	*Plecotus townsendii pallescens*
Pronghorn	*Antilocapra americana*
Pygmy rabbit	*Brachylagus idohoensis*
Raccoon	*Procyon lotor*
Rock squirrel	*Sciurus variegates*
Small-footed myotis	*Myotis ciliolabrum*
Spotted bat	*Euderma maculatum*
Townsend's big-eared bat	*Plecotus townsendii*
Townsend's ground squirrel	*Spermophilus townsendii*
Vagrant shrew	*Sorex vagrans*

Common Name	***Scientific Name***
Western spotted skunk	*Spilogale gracilis*
Wild horse	*Equus caballus*
Wood rat	*Neotoma albigula*
Yuma myotis	*Myotis yumanensis*
Birds	
American kestrel	*Falco sparverius*
American peregrine falcon	*Falco peregrinus aratum*
Ash-throated flycatcher	*Myiarchus cinerascens*
Audubon's warbler	*Dendroica coronata*
Baird's sparrow	*Ammodramus bairdii*
Bald eagle	*Haliaeetus leucocephalus*
Bell's vireo	*Vireo billii arizonae*
Black-headed grosbeak	*Pheucticus melanocephalus*
Black swift	*Cyseloides niger borialis*
Black tern	*Chilidonias niger*
Black-throated sparrow	*Amphispiza bilineata*
Boreal owl	*Aegolius funereus*
Brewer's sparrow	*Spizella breweri*
Cassin's kingbird	*Tyrannus vociferans*
Cliff swallow	*Hirundo pyrrhonota*
Cooper's hawk	*Accipiter cooperii*
European starling	*Sturnus vulgaris*
Ferruginous hawk	*Buteo regalis*
Flammulated owl	*Otus flammeolus*
Golden eagle	*Aquila chrysaetos*
Gray flycatcher	*Empidonax wrightii*
Gray vireo	*Vireo vicinior*
Great-horned owl	*Bubo virginianus*
House finch	*Carpodacus mexicanus*
House sparrow	*Passer domesticus*
Least bittern	*Ixobrychus exilis hesperis*
Loggerhead shrike	*Lanius ludovicianus*
Long-billed curlew	*Numenius americanus*
Lucy's warbler	*Vermivora lucine*
Mexican spotted owl	*Strix occidentalis lucida*
Mountain plover	*Charadrius montanos*
Mourning dove	*Zenaidura macroura*
Northern flicker	*Colaptes auratus*
Northern goshawk	*Accipiter gentilis*
Phainopepla	*Phainopepla nitens*
Prairie falcon	*Falco mexicanus*
Red-tailed hawk	*Buteo jamaicensis*
Red-winged blackbird	*Agelaius phoeniceus*
Rough-legged hawk	*Buteo lagopus*
Sage grouse	*Centrocercus urophasianus*
Sage sparrow	*Amphispiza belli*
Scrub jay	*Aphelocoma coerulescens*
Solitary vireo	*Vireo solitarius*

Common Name	***Scientific Name***
Southwestern willow flycatcher	*Empidonax traillii eximus*
Swainson's hawk	*Buteo swainsonii*
Turkey vulture	*Cathartes aura*
Violet-green swallow	*Tachycineta thalassiana*
Western bluebird	*Sialia mexicana*
Western burrowing owl	*Athene cunicularia hypugea*
White-breasted nuthatch	*Sitta carolinensis*
White-faced ibis	*Plegadis chihi*
Whooping crane	*Grus americana*
Reptiles	
Bandelier Gila monster	*Heloderma suspectum cinctum*
Chuckwalla	*Sauromalus obesus*
Collared lizard	*Crotaphytus collaris*
Desert massasuaga	*Sistrurus catenatus edwardsii*
Desert tortoise	*Gopherus agassizii*
Eastern fence lizard	*Sceloporus undulatus*
Gopher snake	*Pituophis melanoleucus*
Many-lined skink	*Eumeces multivigratus*
Northern sagebrush lizard	*Sceloporus graciosus*
Prairie lizard	*Sceloporus undulates*
Side-blotched lizard	*Uta stansburiana*
Sidewinder snake	*Crotalus cerastes*
Short-horned lizard	*Phrynosoma douglassi*
Striped whipsnake	*Masticophis taeniatus*
Texas horned lizard	*Phrynosoma cornutum*
Texas longnose snake	*Rhinocheilus lecontei*
Western fence lizard	*Sceloporus occidentalis*
Western shovelnose snake	*Chionactis occipitalis*
Whiptail lizard	*Cnemidophorus velox*
Zebra-tailed lizard	*Callisaurus draconoides*
Amphibians	
Canyon tree frog	*Hyla arenicolor*
Jemez Mountain salamander	*Plethodon neomexicanus*
Red-spotted toad	*Bufo puntatus*
Western chorus frog	*Pseudacris triseriata*
Fish	
Bluegill	Lepomis macrochirus
Brook trout	*Salvelinus fontinalis*
Flathead chub	*Platygobio gracilis*
Golden shiner	*Notemigonus crysoleucas*
Goldfish	*Carassius auratus*
Kokanee salmon	*Oncorhynchus nerka*
Mountain whitefish	*Prosopium williamsoni*
Rainbow trout	*Salmo gaidneri*
Shorthead sculpin	*Cottus confusus*
Speckled dace	*Rhinichthys osculus*

Common Name	***Scientific Name***
Plants	
Beatley milk vetch	*Astragalus beatleyae*
Beatley phacelia	*Phacelia beatleyae*
Big sagebrush	*Artemisia tridentata*
Black grama	*Bouteloua eriopoda*
Black woolypod	*Astragalus funereus*
Blackbrush	*Coleogyne ramosissima*
Bluebunch wheatgrass	*Agropyron spicatum*
Bottlebrush squirreltail	*Sitanion hystrix*
Broad-leafed cattail	*Typha latifolia*
Burro bush	*Ambrosia dumosa*
Cane Spring evening primrose	*Camissonia megalanatha*
Cattail	*Typha latifolia*
Checkered lily	*Fritillaria atropurpurca*
Clokey's egg-vetch	*Astragalus oopherus var. clokeyanus*
Cottonwood	*Populus spp.*
Creosote bush	*Larrea tridentata*
Crested wheatgrass	*Agropyron desertorum*
Death Valley beardtongue	*Penstemon fruticiformis var. amargosae*
Delicate rock daisy	*Perityle megaloceplala var. intricata*
Desert thorn	*Lycium spp.*
Eastwood milkweed	*Aschepias eastwoodiana*
Fir	*Abies spp.*
Galleta	*Hilaria jamesii*
Giant wildrye	*Elymus condensatus*
Grama grass cactus	*Pediocactus papyracanthus*
Gray horsebrush	*Tetradymia canescens*
Green rabbitbrush	*Chrysothamnus greenei*
Helleborine orchid	*Epipactis gigantea*
Indian ricegrass	*Oryzopsis hymenoides*
Joshua tree	*Yucca brevifloria*
Juniper	*Juniperus spp.*
Kingston bedstraw	*Galium hilendiae ssp. Kingstonense*
Lemhi milkvetch	*Astragalus aquilonius*
Little bluestem	*Andropogon scoparius*
Low sagebrush	*Artemisia arbuscula*
Needle-and-thread grass	*Stipa comata*
Nevada jointfir	*Ephedra nevadensis*
One-seeded juniper	*Juniperus monosperma*
Pahute Mesa beardtongue	*Penstemon pahutensis*
Pahute Mesa green gentian	*Frasera pahutensis*
Painted milkvetch	*Astragalus ceramicus var. apus*
Parish's phacelia	*Phacelia parishii*
Pinyon pine	*Pinus edulis*
Ponderosa pine	*Pinus ponderosa*
Poverty-weed	*Monolepis mittaliana*
Prickly pear cactus	*Opuntia spp.*
Rabbitbrush	*Chrysothamnus spp.*

Common Name	***Scientific Name***
Ring muhly	*Muhlenbergia torreyi*
Rush	*Juncus spp.*
Sagebrush	*Artemisia spp.*
Saltbush	*Atriplex spp.*
Salt-cedar	*Tamarix pentandra*
Sand dropseed	*Sporobolus cryptandrus*
Sanicle biscuitroot	*Cymopterus ripleyi var. saniculoides*
Sante Fe milkvetch	*Astragalus feenis*
Shadscale saltbush	*Atriplex confertifolia*
Speal-tooth dodder	*Cuscuta denticulata*
Spreading gilia	*Ipomopsis polycladon*
Spruce	*Picea spp.*
Strong prickly pear	*Opuntia valida*
Thickspike wheatgrass	*Agropyron dasytachyum*
Three-square	*Scirpus americanus*
Threetip sagebrush	*Artemisia tripartita*
Torrey rush	*Juncus torreya*
Utah juniper	*Juniperus osteosperma*
Ute’s ladies tresses	*Spiranthes diluvialis*
Western wheatgrass	*Agropyron smithii*
White bearpoppy	*Arctomecon merriami*
White bursage	*Ambrosia dumosa*
White-margined beardtongue	*Penstemon albomarginatus*
Willow	*Salix spp.*
Winged-seed evening primrose	*Camissonia pterosperma*
Winterfat	*Eurotia lanata*
Wire rush	*Juncus balticus*
Wolfberry	*Lycium spp.*
Wood lily	*Lilium philadelphicum var. andinum*
Yellow lady’s slipper orchid	*Cyprepedium calceolus var. pubescens*

APPENDIX H

Federal Register Notices

DEPARTMENT OF ENERGY

National Nuclear Security Administration

Notice of Intent To Prepare an Environmental Impact Statement for The Proposed Relocation of the Los Alamos National Laboratory Technical Area 18 Missions

AGENCY: Department of Energy, National Nuclear Security Administration.

ACTION: Notice of Intent.

SUMMARY: On April 11, 2000, Energy Secretary Bill Richardson announced the Department of Energy's (DOE) proposal to relocate missions at Technical Area 18 (TA–18), a group of facilities at the Los Alamos National Laboratory (LANL), by the end of 2004. Secretary Richardson also announced that an environmental impact study on the proposed transfer of TA–18's missions to another location will begin immediately. Pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended (42 USC 4321 et seq., and the DOE Regulations Implementing NEPA (10 CFR Part 1021), the National Nuclear Security Administration (NNSA), an agency within the Department of Energy, is announcing its intent to prepare an Environmental Impact Statement (EIS) for the Proposed Relocation of the TA–18 Missions.

TA–18 supports important defense, nuclear safety, and other national security missions. Though TA–18 is judged to be secure by the Department's independent inspection office, its facilities are between 30 and 50 years old and are increasingly expensive to maintain and operate. Relocating the TA–18 missions will enable the Department to conduct these missions in a more efficient and cost-effective manner. Currently, DOE expects that the TA–18 Relocation EIS will evaluate the environmental impacts associated with relocating the TA–18 missions to the following alternative locations: (1) A different site at LANL (the preferred alternative) at Los Alamos, New Mexico; (2) the Nevada Test Site (NTS) near Las Vegas, Nevada; (3) the Sandia National Laboratory (SNL) at Albuquerque, New Mexico; and (4) the Argonne National Laboratory—West (ANL–W) near Idaho Falls, Idaho. It is possible that this list of reasonable alternatives may change during the scoping process. The EIS will also evaluate the no-action alternative of maintaining the missions at the current TA–18 location.

DATES: Comments on the proposed scope of the TA–18 Relocation EIS are invited from the public. To ensure consideration in the preparation of the EIS, comments must be postmarked by June 1, 2000. Late comments will be considered to the extent practicable. Public scoping meetings to discuss issues and receive oral comments on the scope of the EIS will be held in the vicinity of sites that may be affected by the proposed action. The public scoping meetings will provide the public with an opportunity to present comments, ask questions, and discuss concerns with DOE/NNSA officials regarding the EIS. The location, date, and time for these public scoping meetings is as follows:

Los Alamos National Laboratory —May 17, 7 p.m.–10 p.m., Betty Ehart Senior Center, 2132 Central Avenue, Los Alamos, NM 87544.

Sandia National Laboratory —May 18, 7 p.m.–10:00 p.m., Albuquerque Convention Center, 401 Second Street, N.W., Albuquerque, NM 87102.

Nevada Test Site —May 23, 7 p.m.–10 p.m., U.S. DOE Nevada Operations Office Auditorium, 232 Energy Way, North Las Vegas, NV 89030.

Argonne National Laboratory —West—May 25, 7 p.m.–10 p.m., The Shilo Inn, 780 Lindsay Blvd., Idaho Falls, ID 83402.

Any agency that desires to be designated as a cooperating agency should contact Mr. Jay Rose at the address listed below by May 31, 2000.

ADDRESSES: General questions concerning the TA–18 Project can be asked by calling 1–800–832–0885, ext. 65484, or by writing to: Mr. Jay Rose, Document Manager, TA–18 Relocation EIS, U.S. Department of Energy/NNSA, 1000 Independence Avenue, S.W., Washington, D.C. 20585.

Comments can be submitted to Mr. Rose at the address above; or faxed to: 1–202–586–0467; or e-mailed to *James.Rose@ns.doe.gov* Please mark envelopes, faxes, and E-mail: ''TA–18 Relocation EIS Comments.''

FOR FURTHER INFORMATION CONTACT: For general information on the NNSA NEPA process, please contact: Mr. Henry Garson, NEPA Compliance Officer for Defense Programs, U.S. Department of Energy/NNSA, 1000 Independence Avenue, SW., Washington, DC 20585; or telephone 1–800–832–0885, ext. 30470. For general information on the DOE NEPA process, please contact: Ms. Carol M. Borgstrom, Director, Office of NEPA Policy and Assistance (EH–42), U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585, telephone 202–586–4600, or leave a message at 1–800–472–2756.

SUPPLEMENTARY INFORMATION: On April 11, 2000, Secretary of Energy Bill Richardson announced that the Department would begin preparation of an EIS on the proposed transfer of TA–18's capabilities and up to approximately 2 tons of special nuclear materials to another location. TA–18, known as the Pajarito Site, consists of a main building, three outlying remote-controlled critical assembly buildings known as ''kivas'', several smaller laboratories, nuclear material storage vaults, and support buildings. The site is located on approximately 130 acres along Pajarito Road. The Los Alamos Critical Experiments Facility (LACEF) and other experimental facilities are located at TA–18, which is situated in the base of a canyon whose walls rise approximately 200 feet on three sides. The three kivas are Category 2 nuclear facilities (i.e., hazard analysis shows the potential for significant on-site consequences) and are within fenced areas to keep personnel at a safe distance during criticality experiments. Additionally, the entire TA–18 is bounded by a security fence to aid in physically safeguarding special nuclear material. Site access is through a guarded portal.

The principal TA–18 activities are the design, construction, research, development, and applications of experiments on nuclear criticality. Excluding security and support personnel, about 80 full-time employees work at TA–18. They provide expertise and knowledge in advanced nuclear technologies that support three primary areas: (1) Critical experiments in support of Stockpile Stewardship and other programs; (2) emergency response in support of counter-terrorism activities; and (3) safeguards and arms control in support of domestic and international programs to control excess nuclear materials. TA–18 is the nation's only facility capable of performing general-purpose nuclear materials handling for a variety of experiments, measurements and training. TA–18 also houses the Western Hemisphere's largest collection of machines for conducting nuclear safety evaluations and establishing limits for operations.

Since 1948, thousands of criticality experiments and measurements have been performed at TA–18 on assemblies using uranium-233, uranium-235, and plutonium-239 in various configurations, including nitrate, sulfate, and oxide compounds as well as solid, liquid, and gas forms. Critical assemblies at TA–18 are designed to operate at low-average power and temperatures well below phase change transition temperatures (which sets them apart from normal reactors) with low fission production and minimal inventory. Special nuclear materials are stored at kivas or in a vault. The on-site TA–18 nuclear materials inventory (about 2 metric tons of special nuclear materials) is relatively stable, and consists primarily of isotopes of plutonium and uranium. The bulk of the plutonium is metal, and is either clad or encapsulated; plutonium oxide is double-canned. The use of toxic and hazardous chemicals is limited. The criticality experiments generate very small amounts of fission products and there is little radioactive waste. Criticality experiments do not release significant emissions to the atmosphere at the site. A more detailed description of TA–18 activities and associated impacts can be found in the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory (January 1999).

Purpose, Need, and Proposed Action

The Department proposes to provide a long-term capability to conduct criticality experiments and evaluations, develop emergency response procedures, and support non-proliferation safeguards and arms control. Since the 1980's, this capability has been based upon the operation of facilities at TA–18, some of which have been operational since 1946. Though TA–18 is judged secure by the Department of Energy's independent inspection office, its facilities are between 30 and 50 years old and are increasingly expensive to maintain and operate. The Defense Nuclear Facilities Safety Board has recommended, in 1993 and 1997, that the Department continue to maintain the capability to support the only remaining criticality safety program in the nation. Consistent with this, the Department wishes to maintain the important capabilities currently provided by TA–18 in a manner that reduces the long-term costs for safeguards and security. Relocating the TA–18 missions would reduce life-cycle costs and improve safeguards and security.

Alternatives

Currently, the NNSA expects that the TA–18 Relocation EIS will evaluate the environmental impacts associated with TA–18 missions at the following DOE sites: (1) a different location at LANL (the preferred alternative); (2) NTS; (3) SNL; and (4) ANL–W. This preliminary list of sites is based on the initial efforts of a Department-wide Option Study Group chartered to develop reasonable alternatives for conducting TA–18 missions. Site screening criteria were developed by the Group that looked for sites with existing Category I (highest level) security infrastructure; nuclear environment, safety and health infrastructure; and compatibility between the site and TA–18 missions. These alternatives are described in greater detail below.

LANL Alternative. This alternative would involve constructing a new facility near the TA–55 Plutonium Facility 4. Consolidating the TA–18 missions near the existing TA–55 facilities could significantly reduce future costs associated with safeguards and security by consolidating safeguards and security requirements. Following construction, the existing Perimeter Intrusion Detection and Assessment System (PIDAS) fence would be expanded to encompass the new facility. Other possible LANL locations for a new facility may also be identified.

NTS Alternative. This alternative would house the TA–18 missions at or near the existing Device Assembly Facility (DAF). The DAF, which became operational in 1998, has the capability to support a variety of nuclear explosive operations (including device assembly, disassembly, modification, staging, testing, repair, and surveillance). Currently, the DAF is used for assembly of sub-critical assemblies, as well as miscellaneous other national security missions. The DAF is approximately 100,000 square feet and has capacity available to accept the TA–18 missions with internal modifications and some minor external construction.

SNL Alternative. This alternative would house the TA–18 missions within TA–V at SNL. Currently, SNL operates a variety of research-oriented nuclear facilities in TA–V. Because existing space in TA–V could accommodate the TA–18 missions, no new buildings would be needed for this alternative. Internal modifications to existing buildings would be required.

ANL–W Alternative. This alternative would house the TA–18 missions in the existing Fuel Manufacturing Facility, and possibly the Transient Reactor Test Facility and other existing facilities. New construction to expand the existing Fuel Manufacturing Facility would be required to accommodate the TA–18 missions. Security upgrades may also be necessary.

As required by the Council on Environmental Quality regulations, the TA–18 Relocation EIS will also evaluate the no-action alternative of maintaining the missions at the current TA–18 location. This alternative would maintain the current missions at Technical Area 18 as described in the expanded use alternative of the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory and Associated Record of Decision (64 FR 50797, September 20, 1999). As stated in the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory, previously planned routine upgrades for infrastructure and security would be conduced in order to maintain the facility.

It is possible that this list of reasonable alternatives may change during the scoping process. In addition, as the EIS is being prepared, the NNSA will be examining the TA–18 missions in order to optimize the number and kind of facilities, and the amount of special nuclear material that would be required to carry out the missions. Following completion of the EIS process, the Secretary of Energy intends to decide where and how to conduct the TA–18 missions, as well as the future use of the existing TA–18 facilities.

Identification of Environmental and Other Issues

The NNSA has identified the following issues for analysis in the EIS. Additional issues may be identified as a result of the scoping process.

1. Public and Worker Safety, Health Risk Assessment: Radiological and non-radiological impacts, including projected effects on workers and the public from construction, normal operations and accident conditions, and decommissioning and decontamination activities associated with relocating and carrying out the TA–18 missions.
2. Impacts from releases to air, water, and soil associated with relocating and carrying out the TA–18 missions.
3. Impacts to plants, animals, and habitats, including threatened or endangered species and their habitats, associated with relocating and carrying out the TA–18 missions.
4. The consumption of natural resources and energy associated with relocating and carrying out the TA–18 missions.
5. Socioeconomic impacts to affected communities from construction and operation associated with relocating and carrying out the TA–18 missions.
6. Environmental justice: Disproportionately high and adverse human health or environmental effects on minority and low-income populations associated with relocating and carrying out the TA–18 missions.
7. Impacts to cultural resources such as historic, archaeological, scientific, or culturally important sites associated with relocating and carrying out the TA–18 missions. Because some facilities at TA–18 are over 50 years old, and potentially important in the context of the Cold War, these will be evaluated for their historical significance under all alternatives.
8. Impacts associated with transportation and storage of nuclear materials.
9. Status of compliance with all applicable Federal, state, and local statutes and regulations; required Federal, state, and tribe environmental consultations and notifications; and DOE Orders on waste management, waste minimization, and environmental protection.
10. Cumulative impacts from the proposed action and other past, present, and reasonably foreseeable actions at the alternative sites.
11. Potential irreversible and irretrievable commitments of resources associated with relocating and carrying out the TA–18 missions.
12. Pollution prevention and waste management practices, including characterization, storage, treatment and disposal of wastes associated with relocating and carrying out the TA–18 missions.

NNSA anticipates that certain classified information will be consulted in the preparation of this EIS and used by decision-makers to decide where and how the capabilities at TA–18 will be carried out. The EIS may contain a classified appendix. To the extent allowable, the EIS will summarize this information in an unclassified manner.

EIS Schedule

The importance of the TA–18 missions requires that the facilities remain operational until the final decision is made and implemented so there is minimal disruption to existing programs or commitments. To support a Record of Decision for this EIS by January 2001, the major milestones for the EIS are shown below.

Public Scoping Meetings: May 2000.

Publish Draft EIS: September 2000.

Draft EIS Public Hearings: October 2000.

Publish Final EIS: December 2000.

Record of Decision: January 2001.

To facilitate this schedule, the TA–18 Relocation EIS will tier from existing EISs for the four alternative sites, as appropriate. For example, the Department has previously prepared Site-Wide EISs for LANL (Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory, January 1999), SNL (Site-Wide Environmental Impact Statement for Sandia National Laboratories, Albuquerque, New Mexico, November 1999), and NTS (Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada, August 1996) that are expected to provide much of the existing environmental information. Additionally, several NEPA documents for ANL–W facilities will be utilized, including the Electrometallurgical Treatment Research and Demonstration Project at ANL–W Environmental Assessment (May 1996) and the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel EIS (Final EIS expected to be published in May 2000).

Public Scoping Process

To assist in defining the appropriate scope of the EIS and to identify significant environmental issues to be addressed, NNSA representatives will conduct public scoping meetings at the locations, dates, and times described above under **DATES.** Each scoping meeting will begin with an overview of the TA–18 missions, the current EIS alternatives, and the proposed EIS scope. Following the initial presentation, NNSA representatives will answer questions and accept comments. Copies of handouts from the meetings will be available to those unable to attend, by contacting the NNSA as described above under **ADDRESSES.**

Issued in Washington, D.C., this 26th day of April, 2000.

T. J. Glauthier,

Deputy Secretary of Energy, Department of Energy.

[FR Doc. 00–10897 Filed 5–1–00; 8:45 am]

BILLING CODE 6450–01–P

DEPARTMENT OF ENERGY

National Nuclear Security Administration

Notice of Schedule Change for Preparing the Environmental Impact Statement for the Proposed Relocation of the Los Alamos National Laboratory Technical Area 18 Missions

AGENCY: Department of Energy, National Nuclear Security Administration.

ACTION: Notice of schedule change.

SUMMARY: On May 2, 2000, the Department of Energy (DOE), National Nuclear Security Administration (NNSA), published a Notice of Intent to prepare an Environmental Impact Statement (EIS) for the Proposed Relocation of the Los Alamos National Laboratory (LANL) Technical Area 18 (TA –18) (hereafter that EIS will be referred to as the TA –18 EIS) (65 FR 25472). In that notice, the NNSA indicated that the TA –18 EIS process was scheduled to be completed by January 2001. The purpose of this notification is to inform the public that the schedule for completing the TA –18 EIS has changed. The NNSA now projects that the EIS process will not be completed before September 2001.

ADDRESSES: General questions concerning the TA–18 Project can be asked by calling 1–800–832–0885, ext. 6–5484, or by writing to: Mr. Jay Rose, Document Manager, TA–18 Relocation EIS, U.S. Department of Energy/NNSA, 1000 Independence Avenue, S.W., Washington, D.C. 20585.

FOR FURTHER INFORMATION CONTACT: For general information on the NNSA National Environmental Policy Act (NEPA) process, please contact: Mr. Henry Garson, NEPA Compliance Officer for Defense Programs, U.S. Department of Energy/NNSA, 1000 Independence Avenue, SW., Washington, DC 20585; or telephone 1–800–832–0885, ext. 30470. For general information on the DOE NEPA process, please contact: Ms. Carol M. Borgstrom, Director, Office of NEPA Policy and Compliance (EH–42), U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585, telephone 202–586–4600, or leave a message at 1–800–472–2756.

SUPPLEMENTARY INFORMATION: On April 11, 2000, Secretary of Energy Bill Richardson announced that the NNSA would begin preparation of an EIS on the proposed transfer to another location of TA–18's capabilities and up to approximately 2 tons of special nuclear materials. In the Notice of Intent, published on May 2, 2000, the NNSA solicited comments on the proposed scope of the TA–18 EIS from the public and conducted public scoping meetings as follows: May 18, 2000, in Albuquerque, New Mexico; May 23, 2000, in North Las Vegas, Nevada; May 25, 2000, in Idaho Falls, ID; and May 30, 2000, in Espanola, New Mexico.

Due primarily to budget constraints, funding for the TA–18 EIS was not available during the summer of 2000 and the schedule for completing the TA–18 EIS began to slip. The events associated with the Cerro Grande fire at LANL (see 65 FR 120, June 21, 2000) further disrupted TA–18 planning activities and added to the schedule slip. The revised EIS schedule is as follows:

Issue Draft EIS—May 2001

Draft EIS Public Hearings—June 2001

Issue Final EIS—August 2001

Record of Decision—September 2001

There have been no significant changes to the TA–18 EIS scope or alternatives, as described in the original TA–18 EIS Notice of Intent.

Issued in Washington, DC, this 18th day of January 2001.

T.J. Glauthier,

Deputy Secretary of Energy, Department of Energy.

[FR Doc. 01–2469 Filed 1–26–01; 8:45 am]

BILLING CODE 6450–01–P

APPENDIX I

Public Participation Process Overview

TA-18

APPENDIX I
PUBLIC PARTICIPATION PROCESS OVERVIEW

I.1 THE PUBLIC SCOPING PROCESS

I.1.1 Scoping Process Description

As a preliminary step in the development of an environmental impact statement (EIS), regulations established by the Council on Environmental Quality (40 CFR 1501.7) and the U.S. Department of Energy (DOE) require "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action." The purpose of this scoping process is: (1) to inform the public about a proposed action and the alternatives being considered, and (2) to identify and/or clarify issues that are relevant to the EIS by soliciting public comments.

On May 2, 2000, The National Nuclear Security Administration (NNSA), a separately-organized agency within DOE, published a Notice of Intent in the *Federal Register* announcing its intent to prepare a *Draft Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory*. During the National Environmental Policy Act (NEPA) process, there are opportunities for public involvement (see **Figure I–1**). The Notice of Intent listed the issues initially identified by DOE for evaluation in the EIS. Public citizens, civic leaders, and other interested parties were invited to comment on these issues and to suggest additional issues that should be considered in the EIS. The Notice of Intent informed the public that comments on the proposed action could be communicated via U.S. mail, a special DOE web site on the internet, a toll-free phone line, a toll-free fax line, or in person at public meetings to be held near the alternative relocation sites.

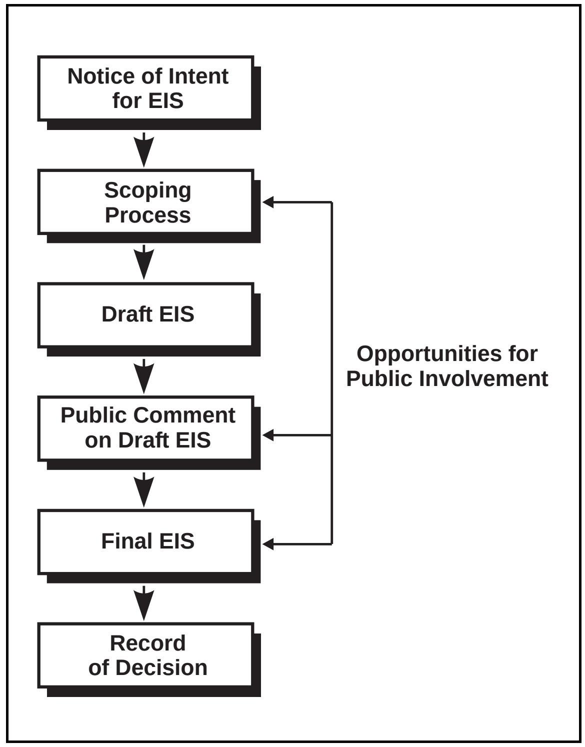

Figure I–1 NEPA Process

Public meetings were held near each of the four alternative relocation sites: (1) Sandia National Laboratories/New Mexico (SNL/NM), on May 18, 2000, in Albuquerque, New Mexico; (2) Nevada Test Site (NTS), on May 23, 2000, in North Las Vegas, Nevada; (3) Argonne National Laboratory-West (ANL-W), on May 25, 2000, in Idaho Falls, Idaho; and (4) Los Alamos National Laboratory (LANL), on May 30, 2000,[1] in Española, New Mexico (see **Figure I–2**).

[1] *Due to the Cerro Grande Fire in the Los Alamos, New Mexico area, the LANL public scoping meeting originally scheduled for May 17, 2000, in Los Alamos was rescheduled to May 30, 2000, in Española, New Mexico.*

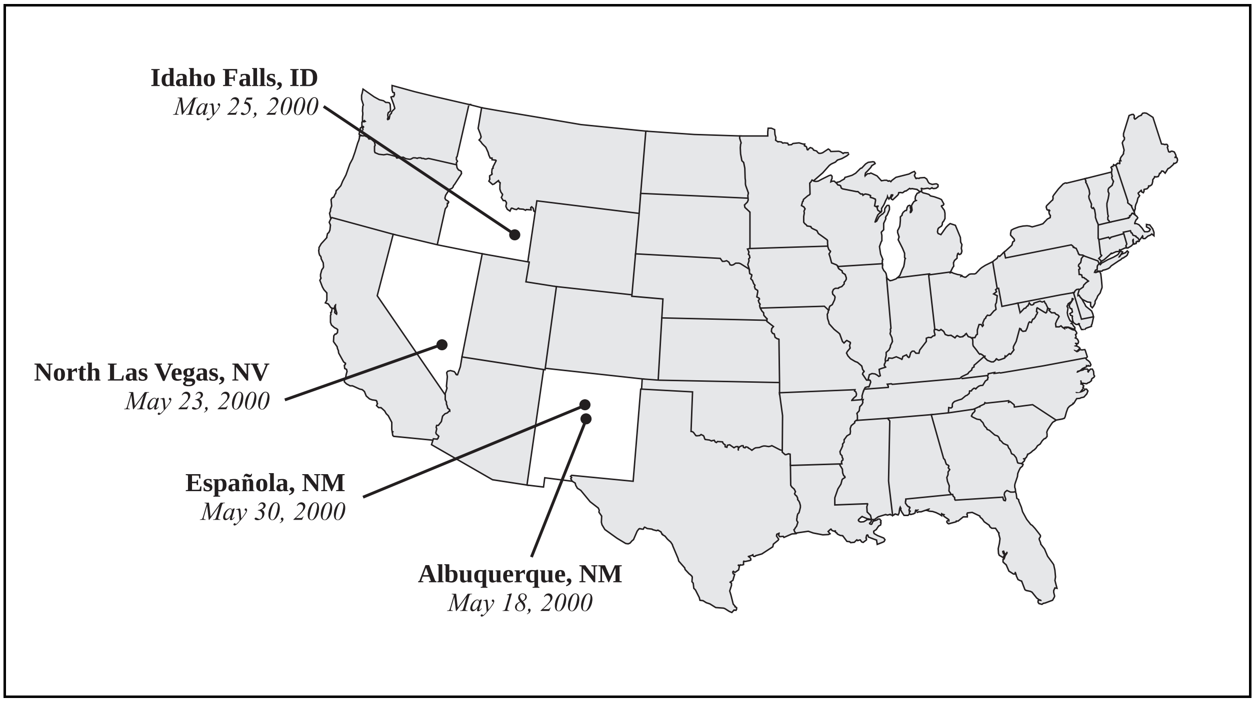

Figure I–2 Public Scoping Meeting Locations and Dates

As a result of previous experience and positive responses from attendees of other DOE NEPA public meetings and hearings, DOE chose an interactive format for the scoping meetings. Each meeting began with a presentation by a DOE representative who explained the proposed Technical Area 18 (TA-18) relocation plan. Afterwards, the floor was opened to questions, comments, and concerns from the audience. DOE representatives were available to respond to questions and comments as needed. The proceedings and formal comments raised at each meeting were recorded verbatim, and a transcript for each meeting was produced. The public was also encouraged to submit written or verbal comments, during the meetings or to submit comments via letters, the DOE internet web site, toll-free phone line, or toll-free fax line, until the end of the scoping period. Due to the rescheduling of the Los Alamos public meeting, necessitated by the Cerro Grande Fire, the end of the scoping period was extended from June 1, 2000 to June 15, 2000. Comments received after June 15, 2000 were considered and included to the extent practicable.

It should be noted that, for EIS public scoping purposes, a comment is defined as a single opinion concerning a specific issue. An individual commentor's public statement may contain several such comments. Most of the verbal and written public statements submitted during the EIS scoping period contained multiple comments on various specific issues. These issues are summarized in the following section.

I.1.2 Scoping Process Results

Nearly 400 comments were received from citizens, interested groups, and Federal, state, and local officials during the public scoping period, including approximately 50 verbal comments made during the public meetings. The remainder of the comments (336) were submitted at the public meetings in written form, or were submitted via mail, internet, fax, or phone over the entire scoping period. Some commentors who spoke at the public meetings also prepared written statements that were later submitted during or after the meetings. Where this occurred, each comment provided by an individual commentor in both verbal and written form was counted as a single comment. It should be noted that a single commentor provided more than 200 of the total scoping comments that were received during the public scoping period.

Many of the verbal and written comments received during the public scoping period identified the need for DOE to describe in detail the existing TA-18 facilities and processes, as well as the specific requirements associated with the alternatives for fulfilling the proposed action. In particular, comments addressed the suitability of other sites to perform TA-18 operations, the design of any facilities to be constructed or modified, construction and operation timelines, and controls to limit releases to the environment.

A significant number of comments also expressed concern about the costs associated with operating TA-18 or relocating these operating capabilities and materials elsewhere. These comments suggested that detailed cost analyses be conducted to analyze the construction, operation, security, and transportation needs of the various alternatives.

Many comments were expressed about the special nuclear materials (SNM) needed to support, and the waste streams resulting from, TA-18 activities. Commentors requested clarification about the amount of SNM that would be required under each alternative, the manner and route of its transport, and the availability of suitable shipping containers. Waste management concerns expressed by commentors included the need to identify the types and volumes of waste generated by the proposed action, the facilities available at each site to treat, store and/or dispose of these wastes, transportation requirements, and compatibility of managing these wastes with state and Federal regulations.

Several commentors expressed concern about environmental, health, and safety risks associated with TA-18 activities. DOE representatives were urged to thoroughly evaluate the potential consequences of the proposed action on local wildlife, water resources, and the health and safety of area residents, and to address the Cerro Grande Fire at LANL in the EIS. Comments also suggested that the EIS quantify all radionuclide and chemical emissions resulting from the proposed action. Concerns also were raised about the safety and security of existing TA-18 facilities, and how safety and security would be addressed at each of the proposed relocation sites. Commentors also expressed favor or opposition to a relocation alternative, reasons for which included security, cost, and workforce advantages.

Public comments and materials submitted during the scoping period were logged and placed in the Administrative Record of this EIS.

I.1.3 Comment Disposition and Issue Identification

Comments received during the scoping period were systematically reviewed by DOE. Where possible, comments on similar or related topics were grouped under comment issue categories as a means of summarizing the comments. The comment issue categories were used to identify specific issues of public concern. After the issues were identified, they were evaluated to determine whether they fell within or outside the scope of the EIS. Some issues were found to be already "in scope," and that they were among the EIS issues initially identified by DOE for inclusion in the EIS. **Table I–1** lists these issues along with where these issues are addressed in the EIS.

As a result of the public scoping process, one additional issue, consideration of an alternative to upgrade the existing TA-18 facilities at LANL, and clarification of the requirements for such an alternative, was added to the scope of the *TA-18 Relocation EIS* (see **Table I–2**).

During the scoping process, DOE received many comments that were judged to be beyond the scope of the *TA-18 Relocation EIS*. The purpose and scope of the *TA-18 Relocation EIS* are only to evaluate the potential environmental impacts associated with the relocation of TA-18 activities. Comments judged to be beyond the scope of the EIS included: (1) national security matters, (2) cost of TA-18 operations, (3) opposition to TA-18 activities, and (4) weapons development activities. These issues are not addressed in the EIS.

Table I–1 Issues Included In the EIS (In Scope)

Issues	*Number of Comments*	*EIS References*
General history of TA-18 and its missions, and the continued importance of current TA-18 operations to national security	15	Section 1.1 and Chapter 3
NNSA's responsibilities under DOE with respect to the proposed action and alternatives	2	Section 1.1.1
Purpose, need, and duration for relocating TA-18 activities	5	Chapter 2 and Section 3.2.1
Unclassified description of the radioactive and non-radioactive materials to be used and the types of experiments to be conducted at the proposed facility, including critical assembly experiments, any uses of cladding, cooling experiments, and storage requirements	19	Section 3.1
Current and proposed use of SNM by TA-18 operations, and its availability	9	Section 3.1.2
TA-18 decontamination and decommissioning, closure, and post-closure plans	5	Section 3.2.1 and Section 5.7
Transportation requirements associated with the proposed action and alternatives	4	Section 3.1.2, Chapter 5, and Appendix D
Unclassified description of the bounding amount of SNM proposed for transport to each candidate location, the manner and route of transport, the containers and casks that would be used to transport this material, necessary safeguards and security measures to protect shipments, and potential accidents associated with this transport	19	Section 3.1.2 and Appendix D
Radionuclide and chemical emissions resulting from the proposed action	7	Section 3.2.1
Time frame for TA-18 operations for all alternatives	3	Section 3.2.1
Potential employment impacts to the TA-18 workforce resulting from the proposed relocation	6	Section 3.2.1 and Chapter 5
Siting criteria used to determine the reasonable site alternatives for the TA-18 operations	3	Section 3.2.2
Description of TA-18 facilities and critical assembly machines, and the specific requirements associated with the alternative proposals for carrying out the TA-18 operations at the alternative sites, including the purpose and design of each facility, timeline and major schedule milestones, any necessary construction, software and security systems to be used, and any systems that would be used to prevent emissions to the environment	36	Section 3.2.1, Section 3.3 and Appendix A
The alternative of discontinuing TA-18 operations	2	Section 3.4.1
Sites that were considered but eliminated from detailed study	6	Section 3.4.2
Environmental, safety, and health impacts of relocating/conducting TA-18 activities over the lifetime of operations at each proposed location	18	Section 3.5 and Chapter 5
DOE's Preferred Alternative	2	Section 3.6
Existing affected environments at each alternative site, including current storage of transuranic materials, as well as releases of radiation from TA-18 normal operations and their effect on workers and the general population	6	Chapter 4
Changes to the affected environment as a result of the Cerro Grande Fire	2	Chapter 4
Accident history of the existing TA-18 facilities and of each alternative relocation site	7	Chapter 4
Seismic and floodplain issues relative to TA-18 operations	3	Chapter 4 and 5
Waste types and volumes that would be generated as a result of the proposed action and alternatives, and how these wastes would be transported/managed at each proposed location	33	Section 3.2.1 and Chapter 5
Environmental justice	1	Chapters 4 and 5 and Appendix E
Potential routes for air, water, and soil contamination from proposed facility operation	1	Chapter 5

Issues	*Number of Comments*	*EIS References*
Applicable laws and regulations associated with the proposed action and alternatives	13	Chapter 6
Consultation with Native American representatives	5	Chapter 6
Reasonable spectrum of accidents (including criticality accidents) associated with the TA-18 proposal	13	Appendix C
Safety measures to prevent criticality accidents	4	Appendix A
Description of recent independent safety evaluations, and other issues associated with safety at TA-18	6	Appendix C
Software and computer codes used in performing the accident analyses in this *TA-18 Relocation EIS*.	4	Appendix C
Impact assessment methodology	1	Appendices B, C, D, E, and F
Summary of public scoping comments on the proposed action and alternatives	1	Appendix I

Table I–2 Issues Added to the Scope of the TA-18 Relocation EIS

Issues	*Number of Comments*	*EIS References*
Consideration of the alternative to upgrade existing TA-18 facilities and clarification of the specific requirements for such an alternative	1	Section 3.3

APPENDIX J

Contractor Disclosure Statement

TA-18

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF EIS FOR THE PROPOSED RELOCATION OF TECHNICAL AREA 18 CAPABILITIES AND MATERIALS AT THE LOS ALAMOS NATIONAL LABORATORY

CEQ regulations at 40 CFR 1506.5(c), which have been adopted by DOE (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project," for the purposes of this disclosure, is defined in the March 23, 1981 guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Question 17a and b.

"Financial or other interest in the outcome of the project 'includes' any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)." 46 FR 18026-18038 at 18031.

In accordance with these requirements, the offeror and any proposed subcontractors hereby certify as follows: (check either (a) or (b) to assure consideration of your proposal)

(a) ✓ Offeror and any proposed subcontractor have no financial interest in the outcome of the project.

(b) _______ Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests:

1.
2.
3.

Certified by:

[signature]
Signature

Richard T. Profant
Name

Corporate Vice President
Integrated Environmental Services Operation

August 3, 2001
Date

Science Applications International Corporation