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Final Environmental Impact Statement for the

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

SUMMARY

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

COVER SHEET

Responsible Agency: United States Department of Energy (DOE), National Nuclear Security Administration (NNSA)

Title: Final 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 with a core team of highly trained nuclear experts. One of the major training facilities for these 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. NNSA wishes to maintain the important capabilities currently provided at TA-18 in a manner that reduces the long-term costs for safeguards and security. NNSA 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 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 (the Preferred Alternative); and (4) the Argonne National Laboratory-West near Idaho Falls, Idaho. The EIS also analyzes the alternatives of upgrading the existing TA-18 facilities and the No Action Alternative of maintaining the operations at the current TA-18 location.

Public Comments: The draft EIS was issued for public review and comment on August 17, 2001. The public comment period was scheduled to end on October 5, 2001, but due to the events of September 11, 2001 the comment period was extended to October 26, 2001. Public hearings to solicit comments on the draft EIS were held in Idaho, Nevada and New Mexico. All comments were considered during the preparation of the final EIS, which also incorporates additional and new information received since the issuance of the draft EIS. In response to comments on the *TA-18 Relocation Draft EIS*, the final EIS contains revisions and new information. These revisions and new information are indicated by a double underline for minor word changes or by a sidebar in the margin for sentence or larger additions. Appendix J contains the comments received during the public review period of the *TA-18 Relocation Draft EIS* and DOE's responses to these comments. DOE will use the analyses presented in this final EIS as well as other information in preparing the Record of Decision for the proposed relocation of TA-18 capabilities and materials at the Los Alamos National Laboratory. DOE will issue this Record of Decision no sooner than 30 days after the U.S. Environmental Protection Agency publishes a notice of availability of this final EIS in the *Federal Register*.

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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

CONVERSIONS

METRIC TO ENGLISH			ENGLISH TO METRIC		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area					
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Concentration					
Kilograms/square meter	0.16667	Tons/acre	Tons/acre	0.5999	Kilograms/square meter
Milligrams/liter	1[a]	Parts/million	Parts/million	1[a]	Milligrams/liter
Micrograms/liter	1[a]	Parts/billion	Parts/billion	1[a]	Micrograms/liter
Micrograms/cubic meter	1[a]	Parts/trillion	Parts/trillion	1[a]	Micrograms/cubic meter
Density					
Grams/cubic centimeter	62.428	Pounds/cubic feet	Pounds/cubic feet	0.016018	Grams/cubic centimeter
Grams/cubic meter	0.0000624	Pounds/cubic feet	Pounds/cubic feet	16,025.6	Grams/cubic meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F - 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cubic meters/second	2118.9	Cubic feet/minute	Cubic feet/minute	0.00047195	Cubic meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.78533	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.314	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1233.49	Cubic meters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons
ENGLISH TO ENGLISH					
Acre-feet	325,850.7	Gallons	Gallons	0.000003046	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

a. This conversion is only valid for concentrations of contaminants (or other materials) in water.

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}
deca-	D	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}

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 474.1-1A)

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.

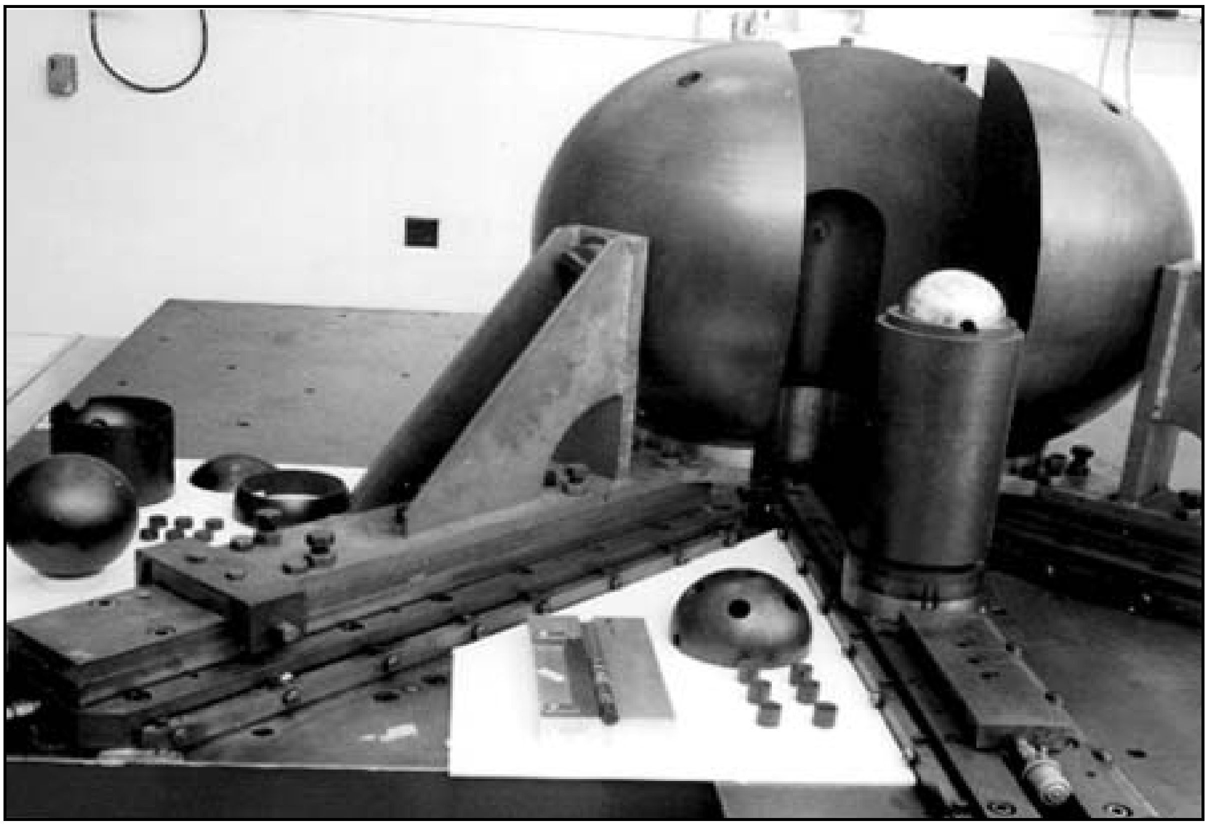
Since 1948, thousands of experiments with several fissile materials (uranium-235 and uranium-233, isotopes of plutonium, and neptunium-237) have been conducted at TA-18. These experiments have been performed with metal or compounds, both bare and reflected, as solid, liquid, and gas throughout the entire 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 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 (the Preferred Alternative); 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.

NNSA is responsible for a number of activities involving the use of nuclear materials and 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 SNM. 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 SNM. 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 are performed routinely. 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 Issues Raised during the Public Comment Period on the Draft EIS

In August 2001, DOE published the *Draft Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory*. The regulations implementing the National Environmental Policy Act (NEPA) mandate a minimum 45-day public comment period after publication of a draft EIS to provide an opportunity for the public and other stakeholders to comment on the EIS analysis and results. The 45-day public comment period on the *TA-18 Relocation Draft EIS* began on August 17, 2001, and was scheduled to end on October 5, 2001. As a result of the events of September 11, 2001, the comment period was extended an additional 21 days to October 26, 2001. During this 71-day comment period, public hearings were held in Idaho Falls, Idaho; Las Vegas, Nevada; and Albuquerque and Española, New Mexico. In addition, the public was encouraged to submit comments via the U.S. mail service, electronic mail, a toll-free 800-number phone line, and a toll-free fax line.

The majority of the comments expressed a preference for specific alternatives evaluated in the EIS. Reasons for opposing particular alternatives are provided below.

Reasons cited for opposition to a new facility at LANL included reduced safety, reduced operational flexibility, and high cost. A reason cited for opposition to all sites at LANL was the adverse impact of LANL operations in general on Native American resources.

Reasons cited for opposition to the NTS Alternative were the compounded impacts from the Yucca Mountain project and the overall cost of cleanup at NTS.

Reasons cited for opposition to the ANL-W Alternative were the inefficiency in operations introduced by having LANL personnel working at ANL-W in a campaign mode; potential wildfires; the transportation of nuclear materials through tribal lands; the "inadequate" infrastructure at ANL-W; and "difficult" compliance to numerous state regulations.

NNSA acknowledges the support for and opposition to the alternatives considered in the *TA-18 Relocation EIS* and the issues behind the commentors' positions. With the exception of cost, all the issues raised have been considered in the draft EIS. Although cost is one of several factors that will be considered by the decision makers in the Record of Decision, it is beyond the scope of the *TA-18 Relocation EIS*, which focuses on assessing the potential environmental impacts of the proposed action and reasonable alternatives. Based on analyses conducted after publication of the *TA-18 Relocation Draft EIS*, NNSA has concluded that relocating the security Category I/II activities to the Nevada Test Site is the Preferred Alternative.

Some of the commentors provided suggestions for improving the EIS. Among those were suggestions to consider the normal operations direct dose to workers and the public from TA-18 activities; to include mitigation actions for air quality impacts from construction activities of the proposed new facility at LANL; to clarify DOE's plans for decontamination and decommissioning of existing and proposed new facilities; to include considerations of sabotage in the environmental impacts analysis; to provide additional information regarding accident histories for the proposed sites; and to address the weapons-related nature of the operations at the proposed sites.

NNSA considered the commentors' suggestions and provided clarifications and revisions in the final EIS, as indicated in Section S.1.2.3 below. None of these revisions constitute significant changes to the environmental impacts presented in the *TA-18 Relocation Draft EIS*.

A commentor criticized NNSA and the draft EIS on a number of issues including: failure to clearly state the missions; stating a Preferred Alternative without providing reasons; inadequacy of decontamination and decommissioning plans; not addressing groundwater contamination issues at TA-18; not addressing terrorist attacks; and not addressing past LANL procedural violations, which raises potential safety concerns. The commentor also suggested that existing radioactivity monitoring on behalf of public safety be relocated along with the other capabilities and that the existing practice of training International Atomic Energy Agency inspectors continue to be part of the activities at the relocated facilities.

In general, NNSA does not agree that the issues raised by the commentor constitute weaknesses in the draft EIS. NNSA's response to the major issues raised by the commentor is summarized below.

With respect to the TA-18 missions, Chapter 2 (Summary Section S.1.1) of the *TA-18 Relocation EIS* discusses the reasons DOE proposes to relocate TA-18 capabilities and materials and the objectives to be achieved. As stated in Chapter 2, DOE needs to maintain the capability to conduct criticality experiments. In addition, TA-18 mission operations and the facilities, personnel, and materials required to support these operations have been described in detail in Section 3.1 of the *TA-18 Relocation EIS*. This section also outlines the TA-18 missions, including Nuclear Materials Management and Criticality Safety, Emergency Response, Nonproliferation and Safeguards and Arms Control, and Stewardship Science. NNSA would continue to perform these TA-18 mission operations at a new location. Relocating TA-18 would not prejudice any future decisions with respect to other activities at LANL such as analytical chemistry, security, and plutonium pit manufacturing.

Issues related to decontamination and decommissioning of TA-18 activities are presented in Section 5.7 (Summary Section S.6.6). As stated in that section, prior to the initiation of decommissioning activities, a detailed decontamination and decommissioning plan would be prepared. A separate NEPA review would be undertaken prior to the commencement of decontamination and decommissioning activities.

Issues related to the security of relocated TA-18 capabilities and materials, including sabotage, are covered in a classified appendix to the *TA-18 Relocation EIS*.

With respect to groundwater contamination at TA-18, shallow groundwater monitoring to date has shown that there are no significantly elevated concentrations of contaminants at TA-18. The Environmental Restoration Project at LANL has investigated potential release sites at the laboratory, including TA-18. These potential release sites are scheduled for additional characterization in future years, and alluvial well sampling is ongoing. DOE has not made a decision about the ultimate disposition of the TA-18 facilities if the missions are relocated. Further NEPA analysis would be done to support a decision about disposition and would address cleanup of any existing contamination.

NNSA acknowledges that there have been technical safety requirement violations at TA-18 in the past. As part of NNSA's approach to integrated safety management, LANL has taken corrective actions to resolve these violations by implementing procedures and personnel training. Although not all corrective actions have met the complete satisfaction of the DOE's Office of Enforcement, LANL is continuing to improve quality assurance and procedures in an effort to eliminate procedural violations.

Properly located radioactivity monitoring of the TA-18 mission activities would continue if they remain at LANL. The missions would continue to include training activities in support of International Atomic Energy Agency and other programs.

The detailed comments and NNSA's responses are included in Appendix J of Volume 2 of this *TA-18 Relocation EIS*.

S.1.2.3 Changes from the Draft EIS

In response to comments on the *TA-18 Relocation Draft EIS*, the final EIS contains some revisions. These revisions are indicated by a double underline for minor word changes or by a side bar in the margin for sentence or larger additions. Appendix J contains the comments received during the *TA-18 Relocation Draft EIS* public comment period and DOE's responses to these comments. The most important changes included in the final EIS are provided below.

Issues raised during the public comment period

A new Section 1.6 (Summary Section S.1.2.2) was added to summarize the issues raised during the public comment period.

Changes from the draft EIS

A new Section 1.7 (Summary Section S.1.2.3) was added to list the changes included in the final EIS.

Other related NEPA reviews

Section 1.4 (Summary Section S.1.2.4) was revised to include information from NEPA documents published since the issuance of the *TA-18 Relocation Draft EIS*.

Preferred Alternative

Section 3.6 (Summary Section S.5) was revised to reflect the new Preferred Alternative to relocate the security Category I/II activities to NTS.

Direct dose to workers and public

Sections 4.2.11.1, 5.2.10.1, 5.3.10.1, 5.4.10.1, 5.5.10.1, and 5.6.3.10 were revised to address the direct dose to the public from TA-18 normal operation activities.

Consideration of sabotage activities

Section 5.1 and Appendix C, Section C.2, were revised to clarify the issue of including sabotage considerations in the EIS.

Accident history

Sections 4.2.11.4, 4.3.11.4, 4.4.11.4, and 4.5.11.4 were revised to provide additional information regarding accident histories for the proposed sites.

Mitigation measures during construction

Section 5.9 was revised to include mitigation measures for air quality impacts during construction of proposed new facilities.

Nevada Test Site map

Figure S–23 in the Summary and Figures 4–22 and 4–30 in Volume 1 were revised to correct errors related to the location of the boundaries.

Cumulative Impacts

Section 5.3.14 was revised to include information obtained from the *Environmental Assessment for the Sandia Underground Reactor Facility*.

Section 5.4.14 was updated to reflect recent information obtained from the *Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain*.

S.1.2.4 Relationships to Other Actions and Programs

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 S.1.2.4.1; ongoing actions are discussed in Section S.1.2.4.2.

S.1.2.4.1 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 (55 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 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.

Final Environmental Assessment for the Sandia Underground Reactor Facility (DOE/SA-1392)—On November 13, 2001 DOE issued the *Environmental Assessment for the Sandia Underground Reactor Facility* and a Finding of No Significant Impact for construction and operation of an underground facility designed for housing the Sandia Pulsed Reactors, discontinue use of the existing facility, and provide storage for SNM at TA-V[1], should they be relocated to SNL/NM. The construction and operation of this facility would parallel the construction and operation of the facility proposed for the TA-18 missions.

S.1.2.4.2 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*.

Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada (DOE/EIS-0250)—The *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* was issued in February 2002. This EIS analyzes a Proposed Action to construct, operate and monitor, and eventually close a geologic repository for the disposal of spent nuclear fuel and high-level radioactive waste at Yucca Mountain in Nye County, Nevada located near NTS. The concern of transporting TA-18 SNM to the NTS DAF in combination with the movement of material to Yucca Mountain has been discussed in the *TA-18 Relocation EIS*.

Environmental Impact Statement for the Proposed Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, NM—On July 23, 2002, DOE and NNSA announced its intent to prepare an *Environmental Impact Statement for the Proposed Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, NM* (CMRR EIS) (67 FR 48160). The purpose of this EIS is to assess the consolidation and relocation of mission critical chemistry and metallurgy research (CMR) capabilities at LANL from degraded facilities such that these capabilities would be available on a long-term basis to successfully accomplish LANL mission support activities or programs. The contributory effect of releases and emissions from the CMR facility are included in the baseline descriptions of LANL presented in the *TA-18 Relocation EIS*.

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

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

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 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
- 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.

<u>NTS Alternative</u>—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.

<u>ANL-W Alternative</u>—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.

<u>No Action Alternative</u>—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 *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

DAF = Device Assembly Facility; FMF = Fuel Manufacturing Facility; 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 operational characteristics of the critical assembly machines form the basis for the impact analysis at all other locations. These characteristics, based on the operation of TA-18 facilities as described in the

LANL SWEIS for a projected Expanded Operations Alternative, 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 the 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.

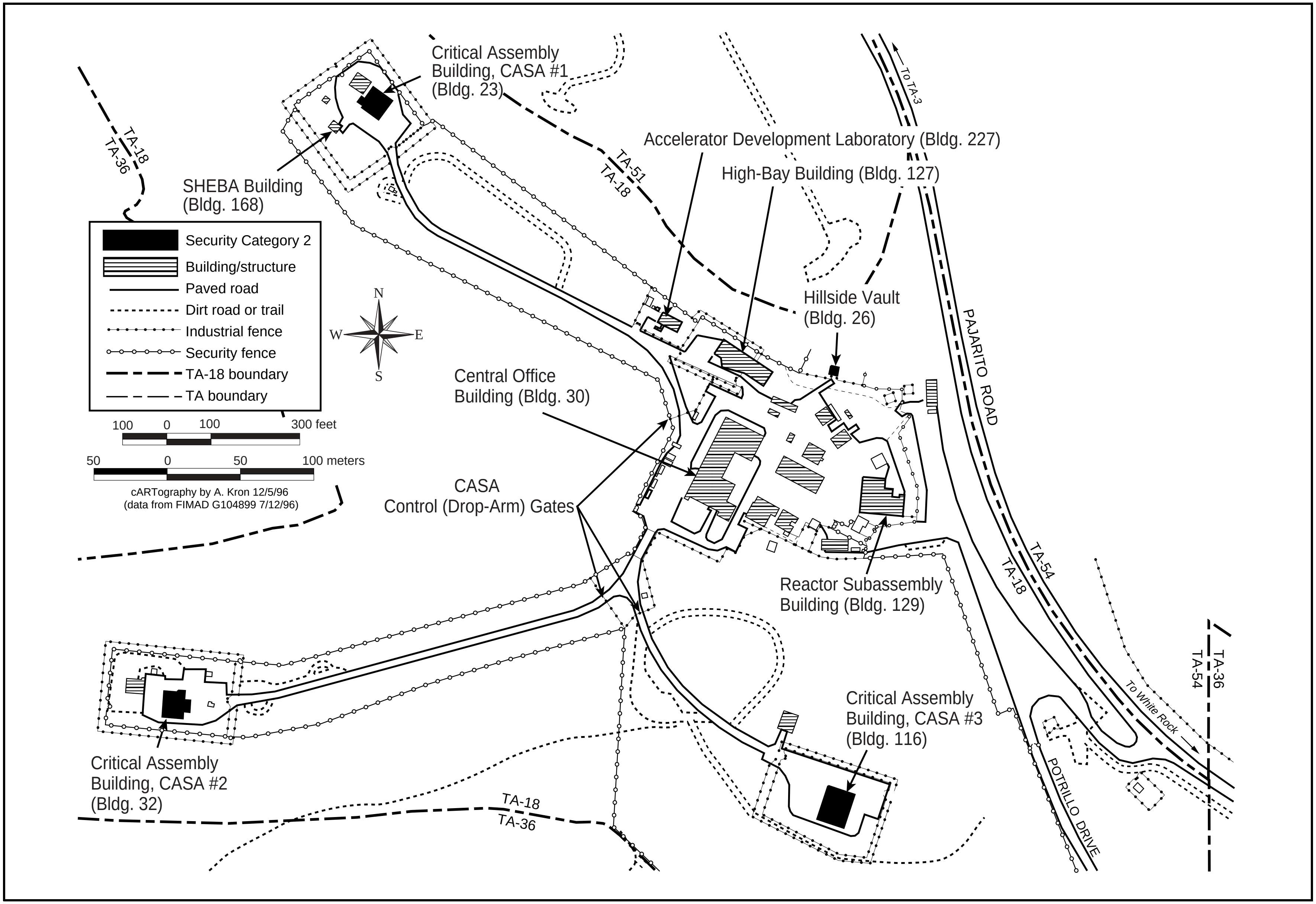


Figure S–1 TA-18 Pajarito Site

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.

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

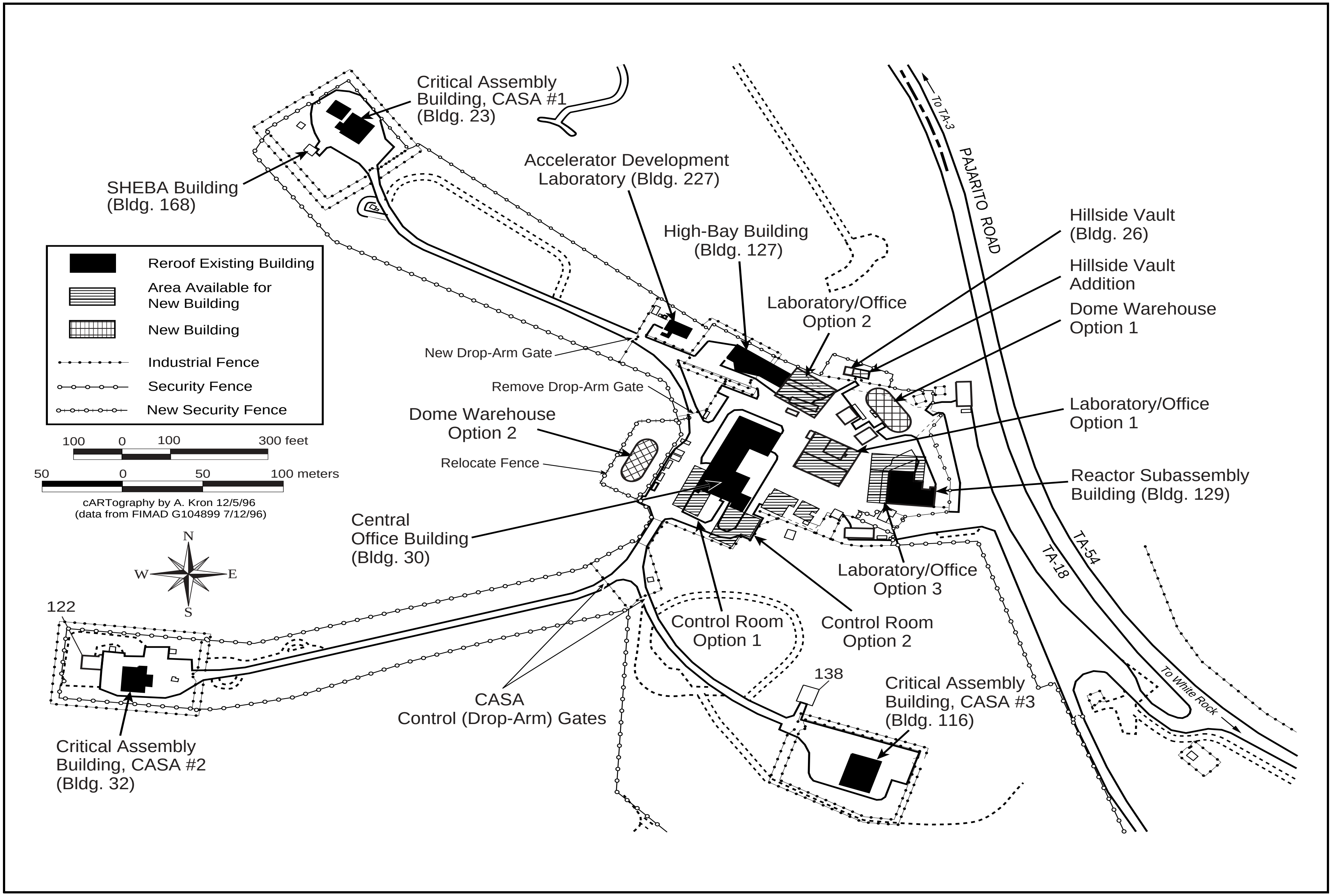


Figure S–2 TA-18 Proposed Modifications Plan (TA-18 Upgrade Alternative)

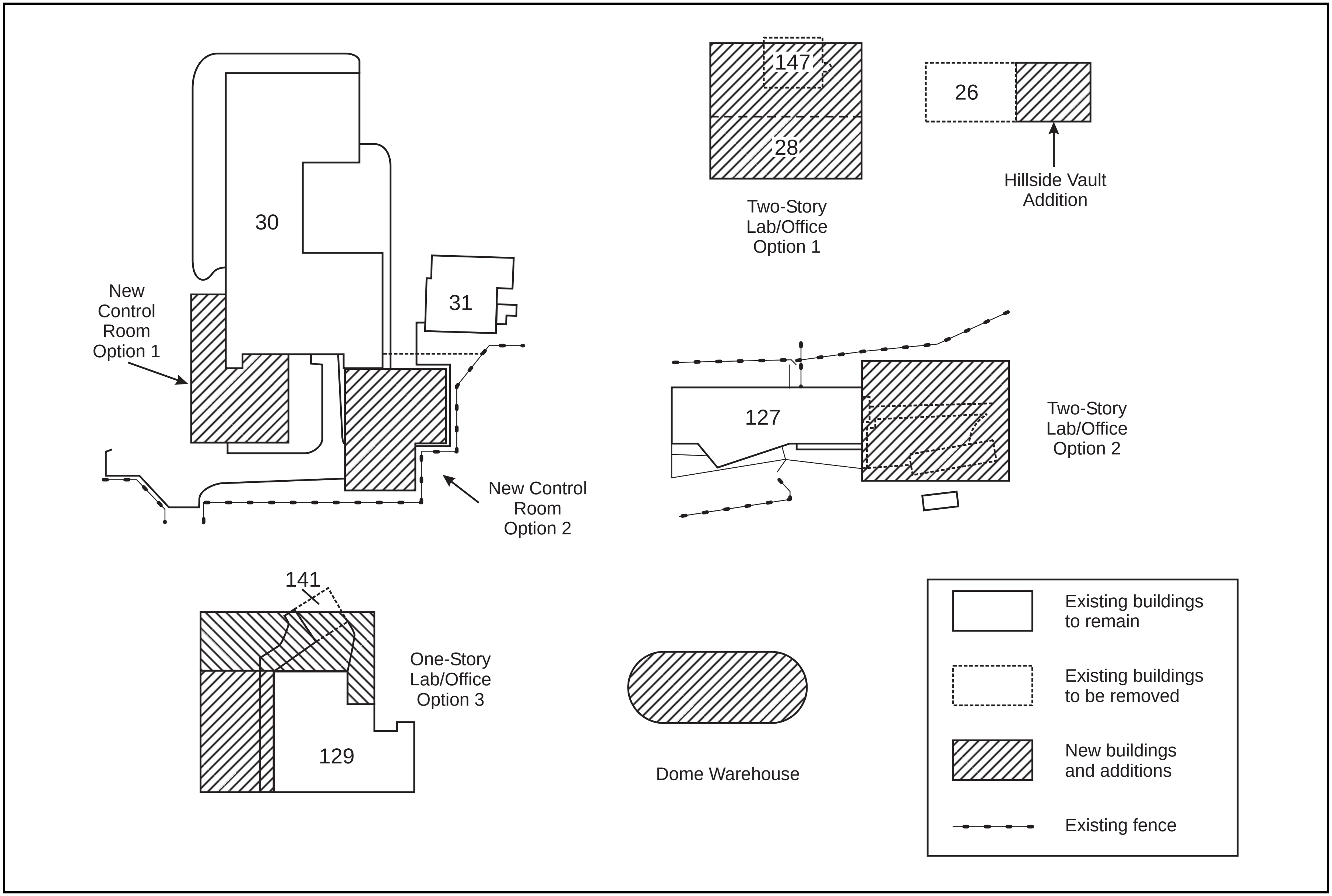


Figure S–3 TA-18 Proposed New Construction (TA-18 Upgrade Alternative)

- 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).

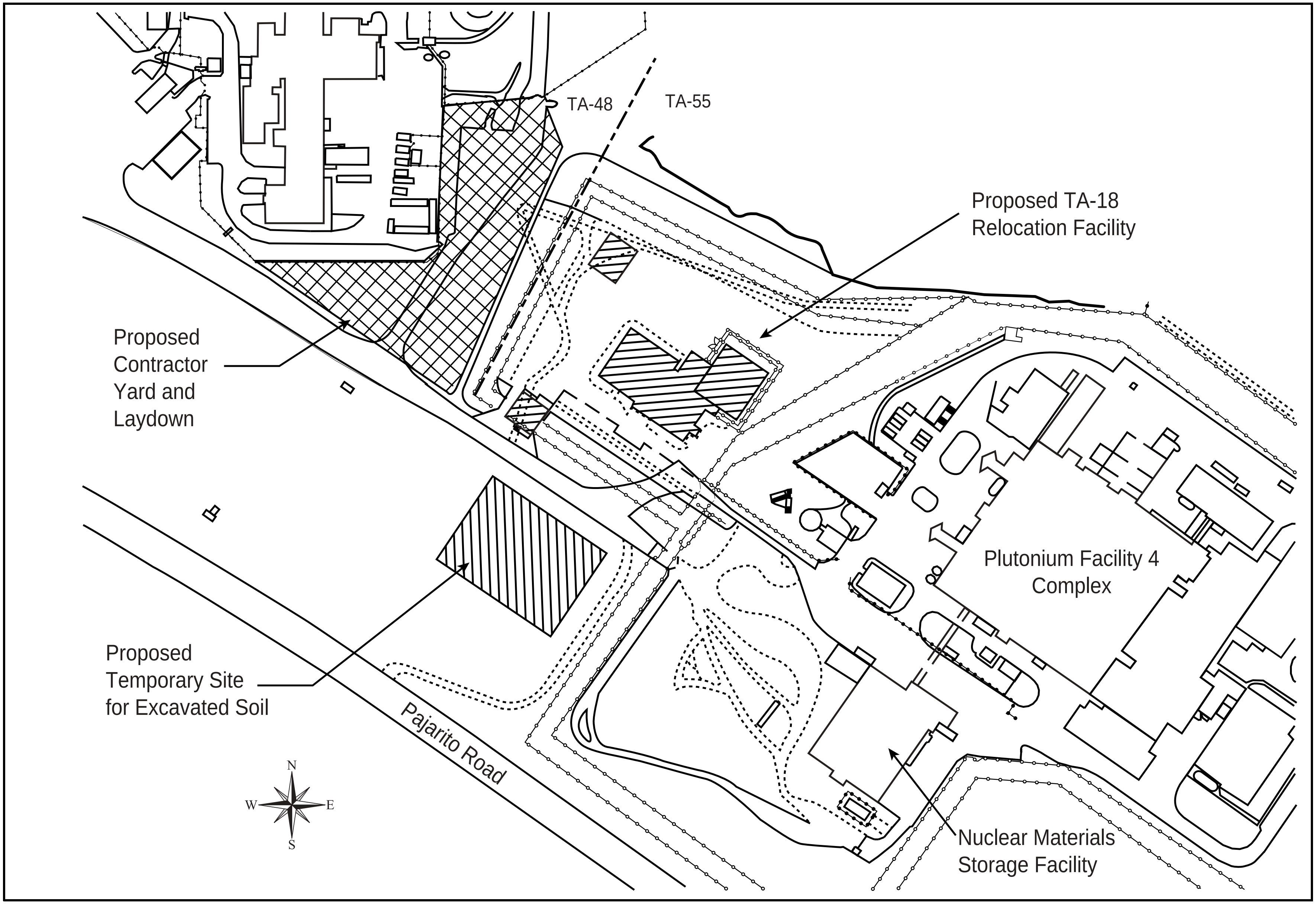


Figure S–4 Location of the Proposed New Facility (LANL New Facility Alternative)

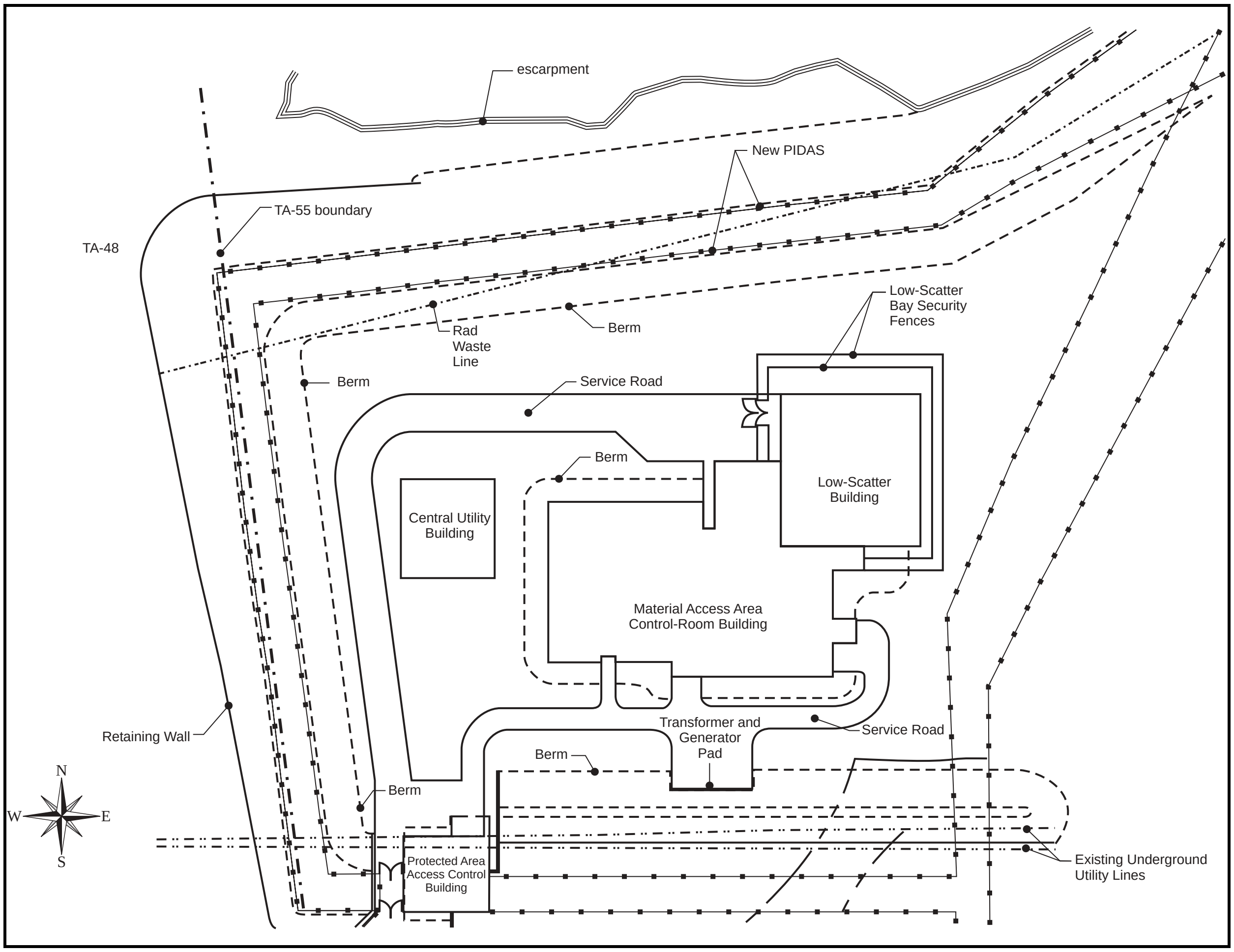


Figure S–5 Site Plan for Proposed LANL Facility (LANL New Facility Alternative)

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.

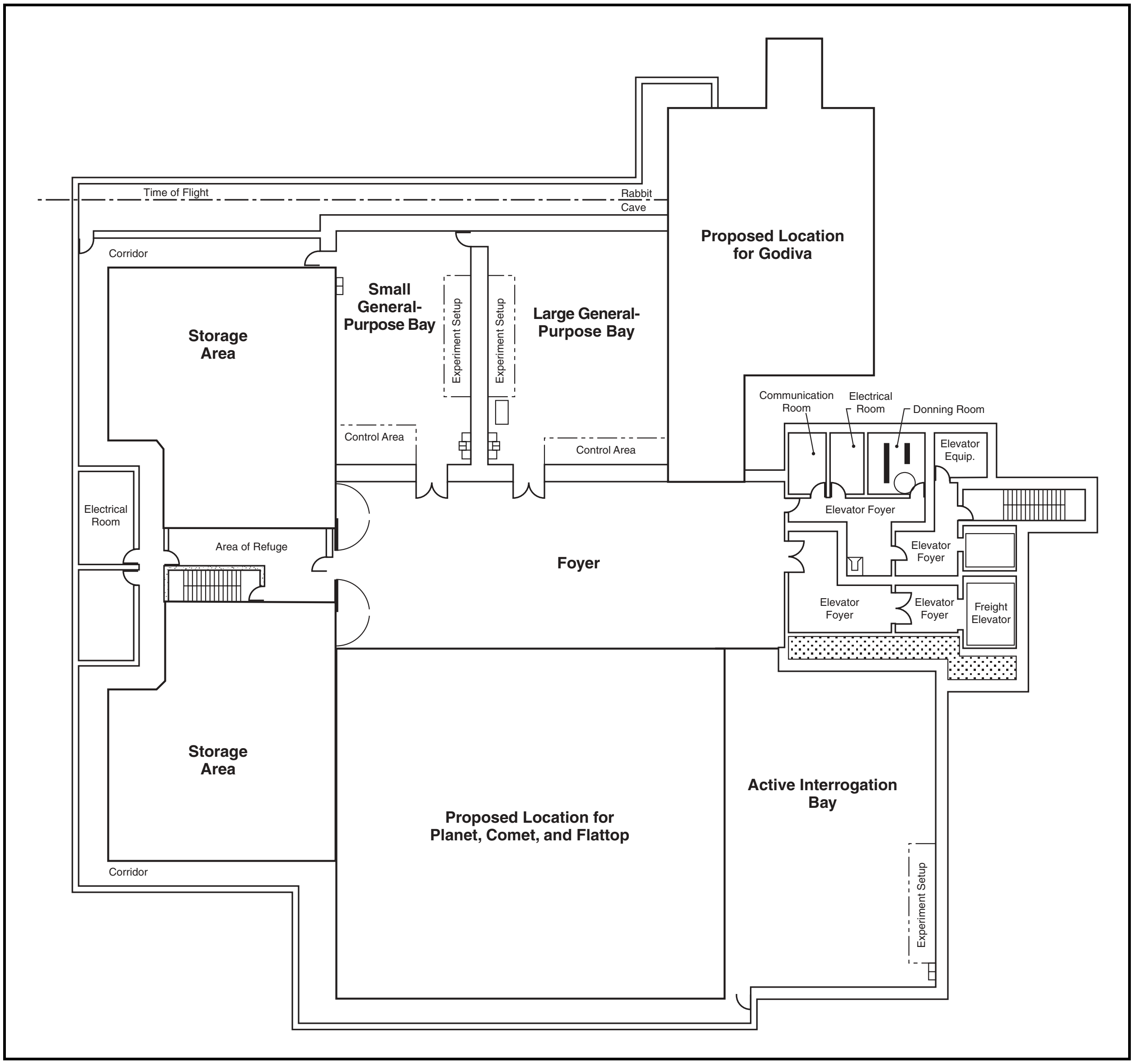


Figure S–6 Location of Critical Assembly Machines and SNM Vaults

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).

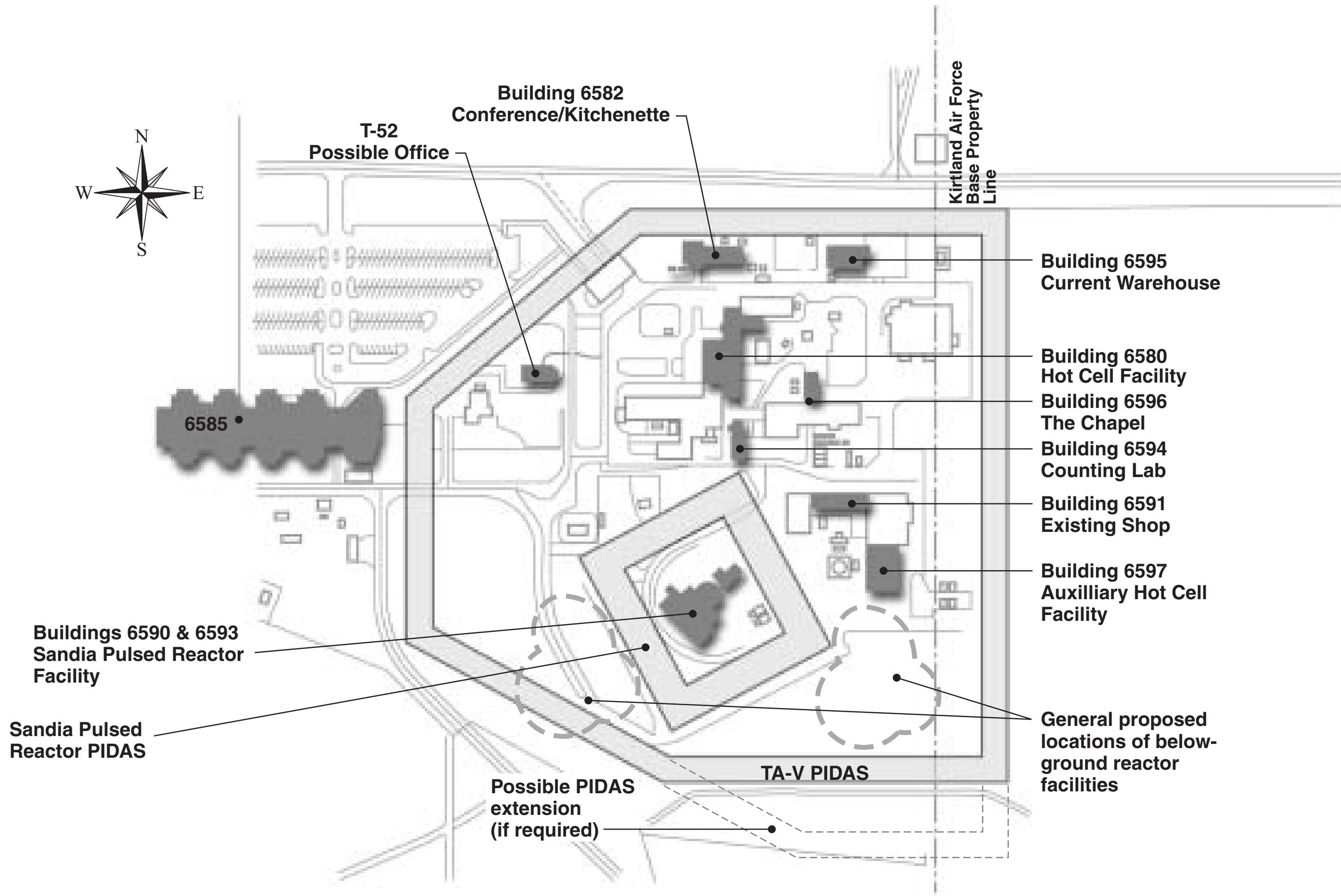


Figure S–7 Proposed New SNL/NM Facility and Existing Facilities (SNL/NM Alternative)

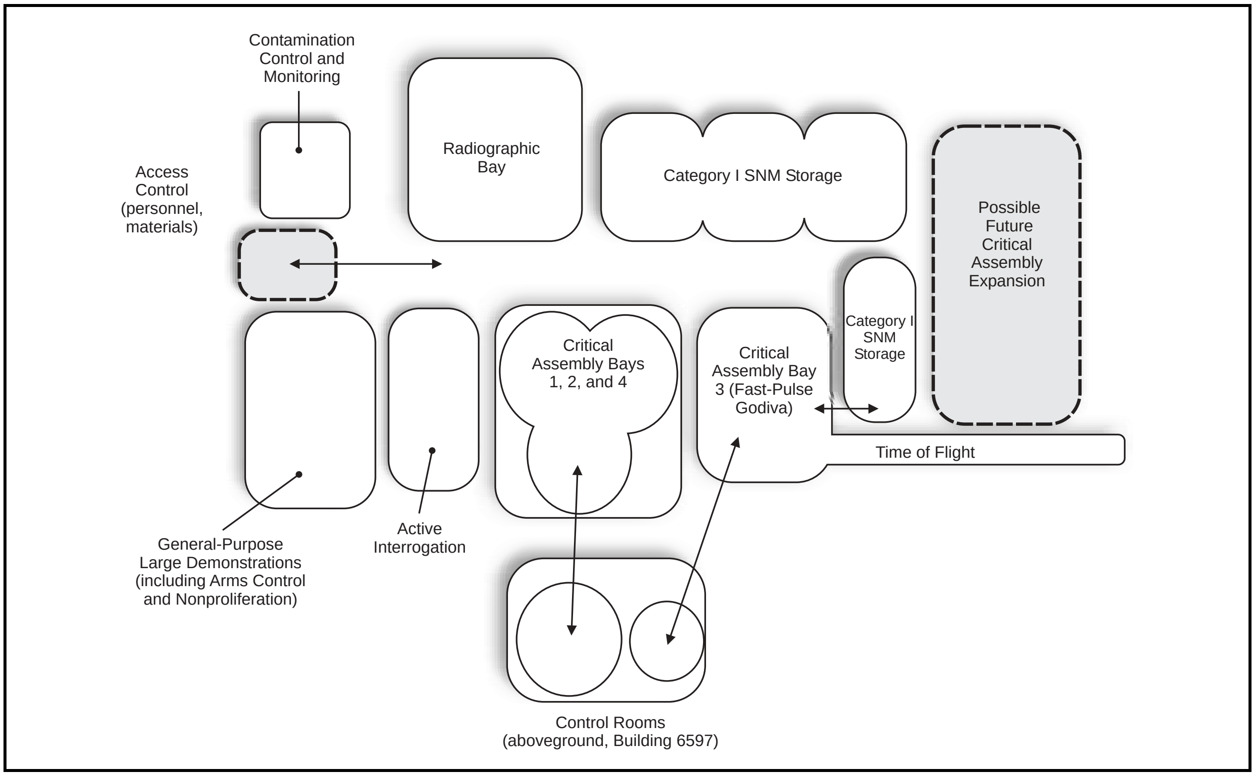


Figure S–8 Schematic of the Underground Facility (SNL/NM Alternative)

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 assembly cell is designed and tested to undergo an explosion from a maximum high-explosive device 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

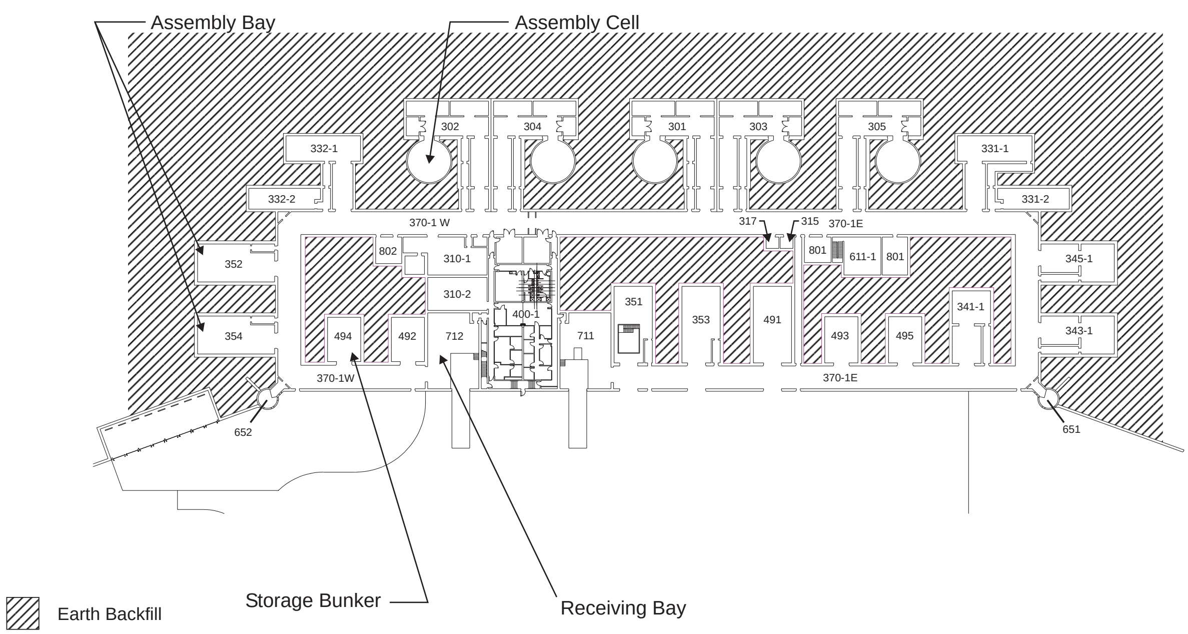


Figure S–10 DAF Floor Plan

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.

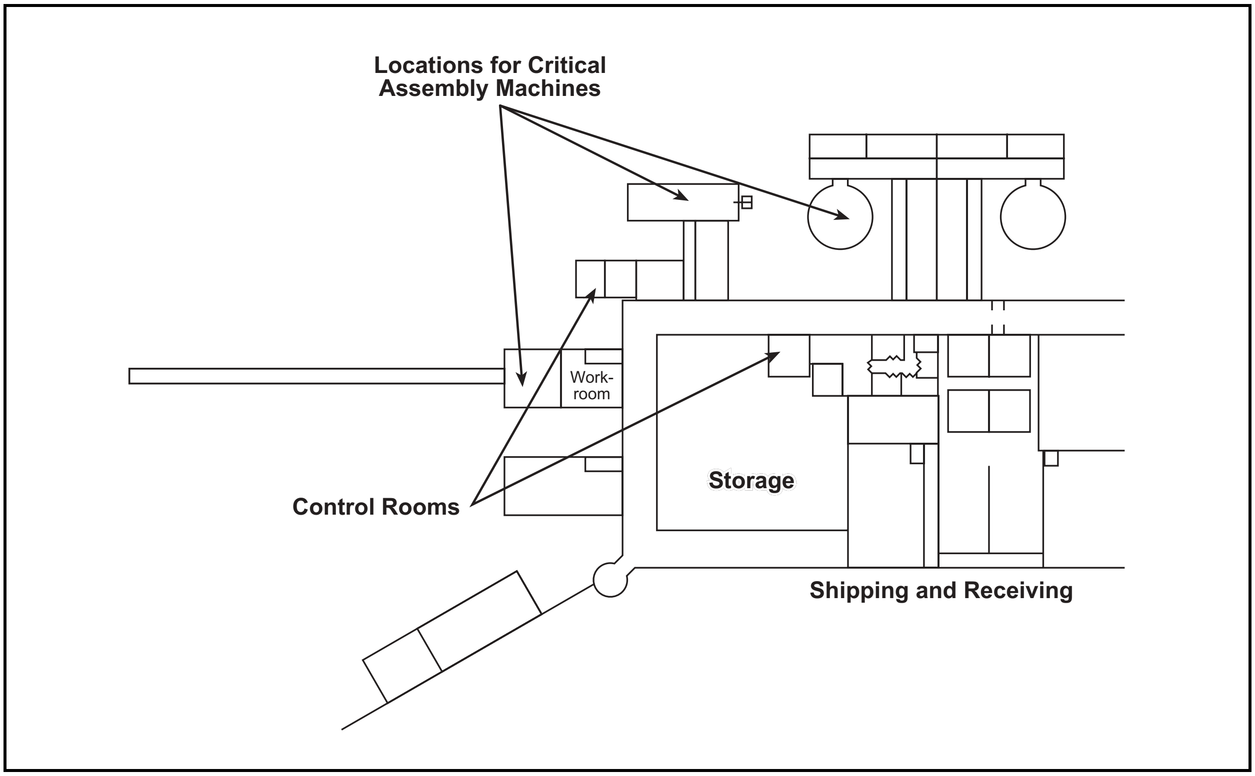


Figure S–11 DAF Critical Assembly Layout

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

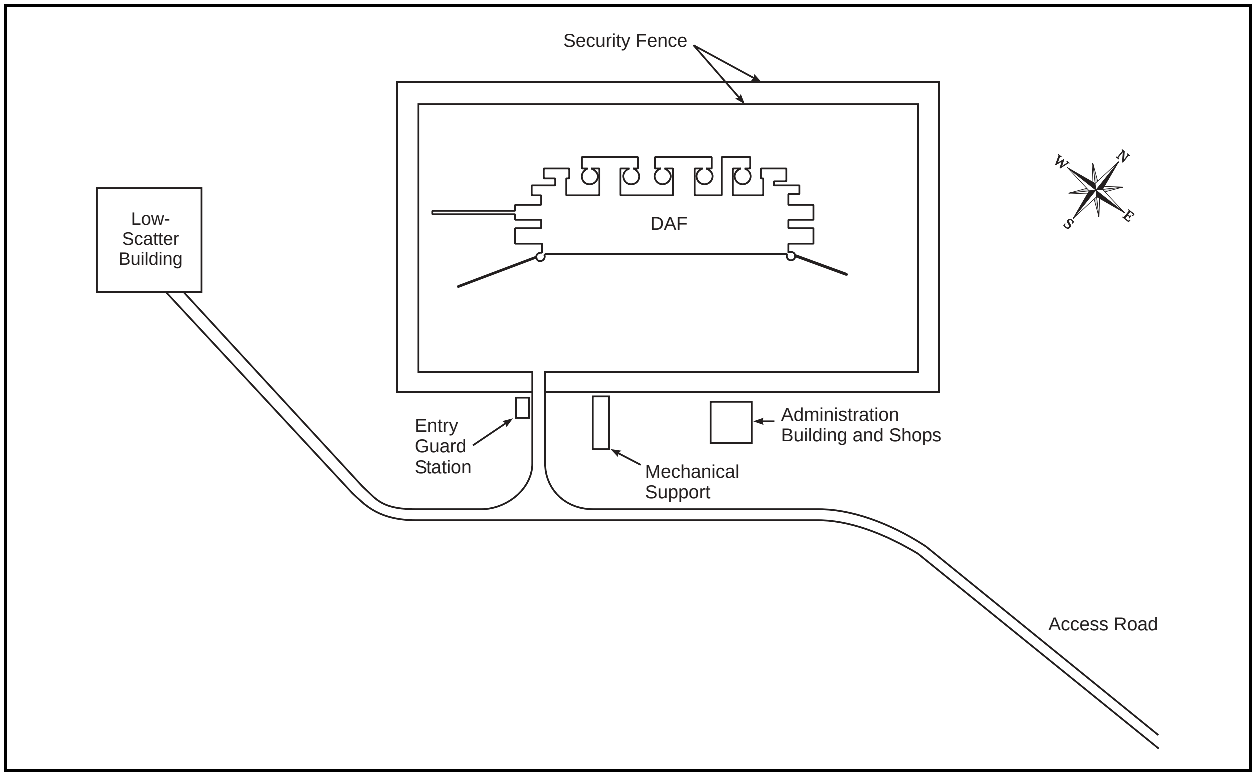


Figure S–12 DAF Layout Site Vicinity

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.

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).

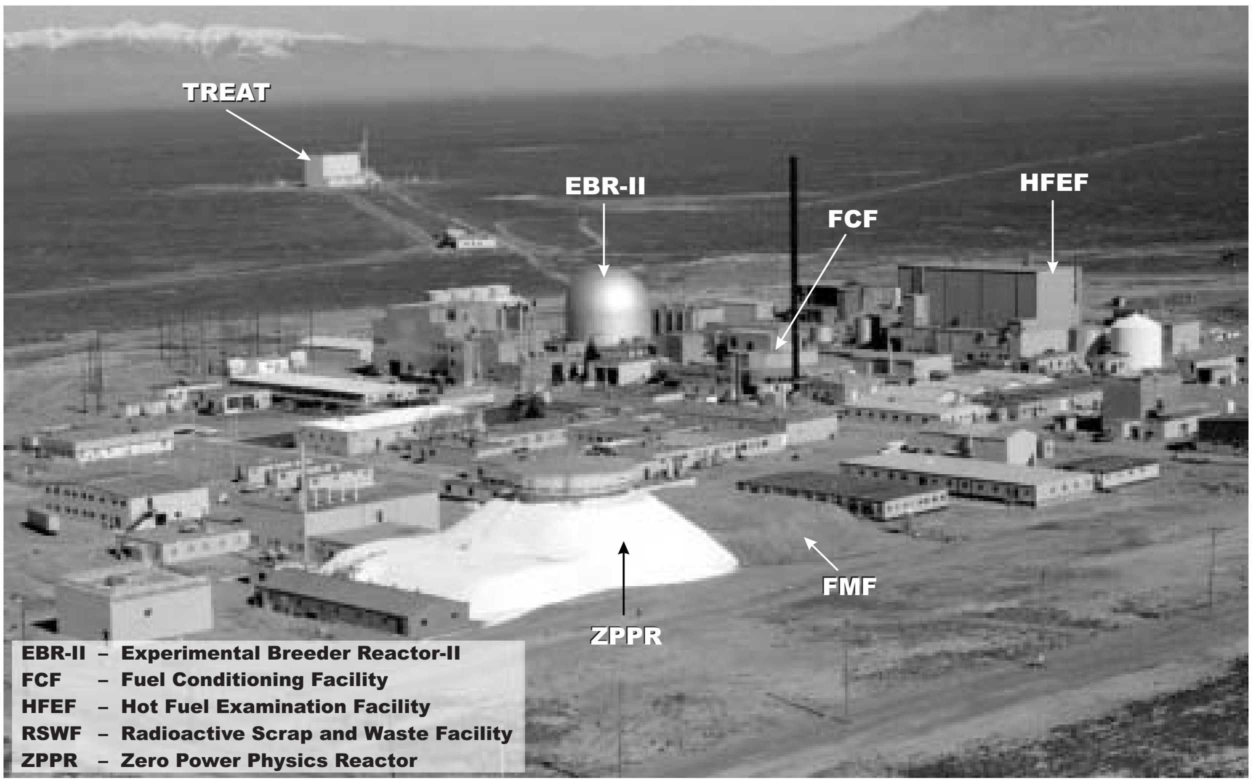


Figure S–13 ANL-W Site

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).

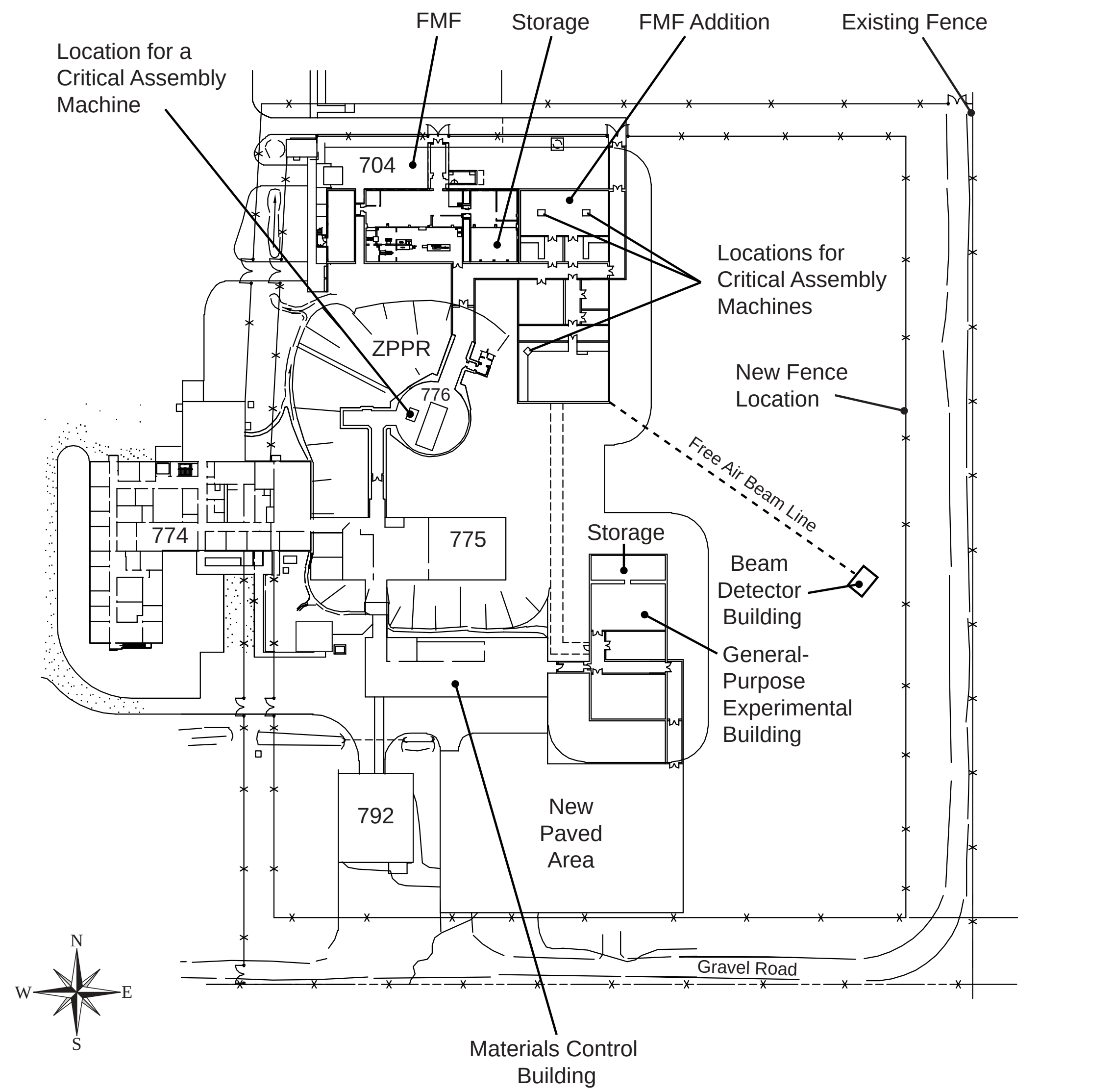


Figure S–14 Proposed Relocation Layout (ANL-W Alternative)

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.

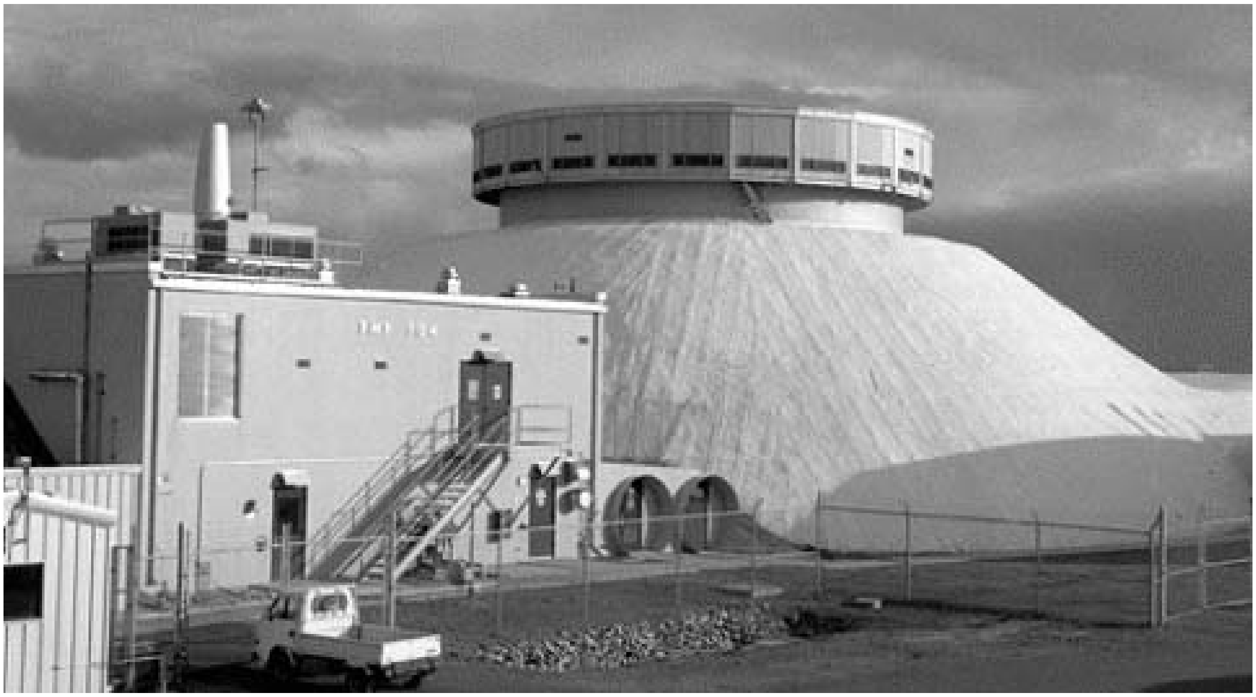


Figure S–15 FMF and ZPPR Facilities

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**.

Figure S–16 EBR-II Facility

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.

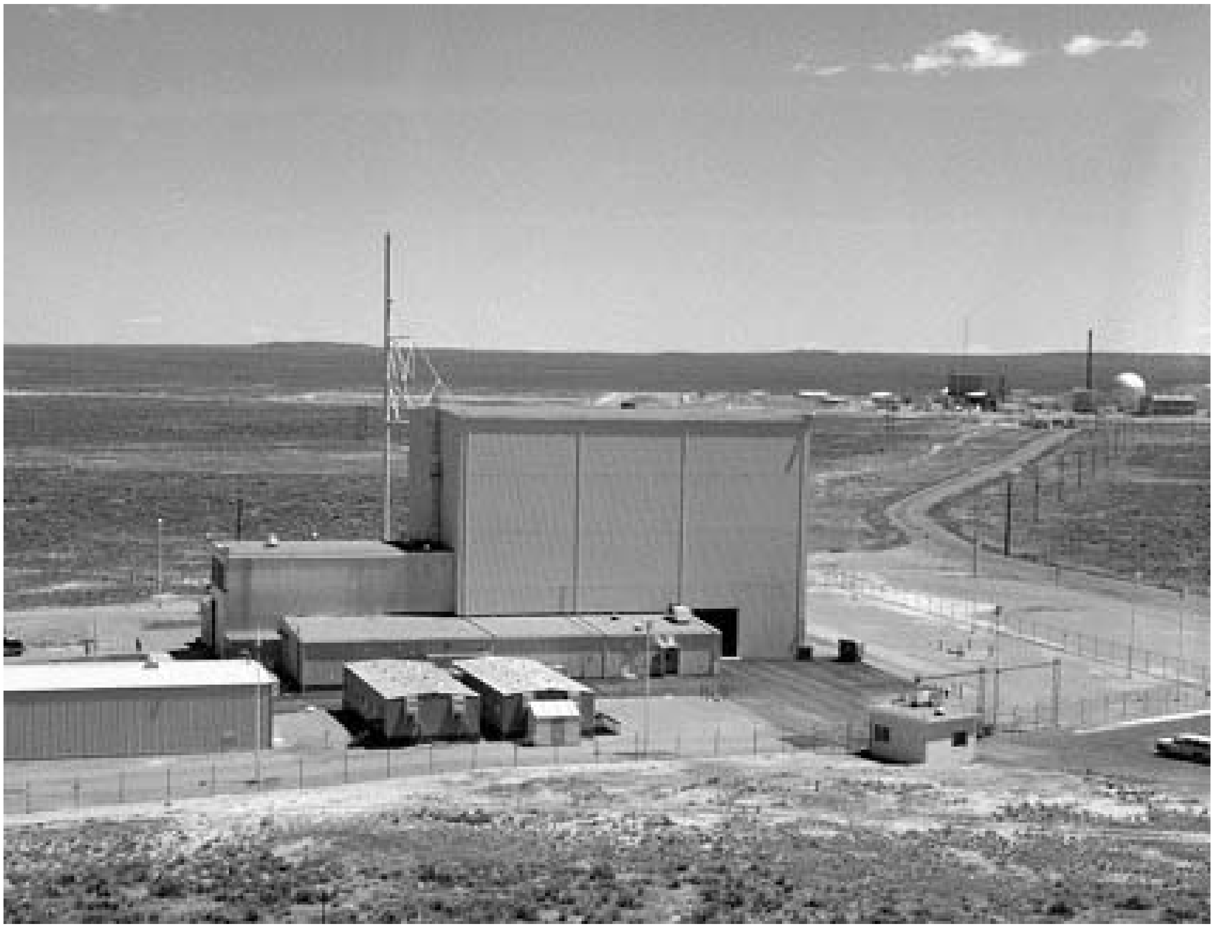


Figure S–17 TREAT Facility

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.

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**.

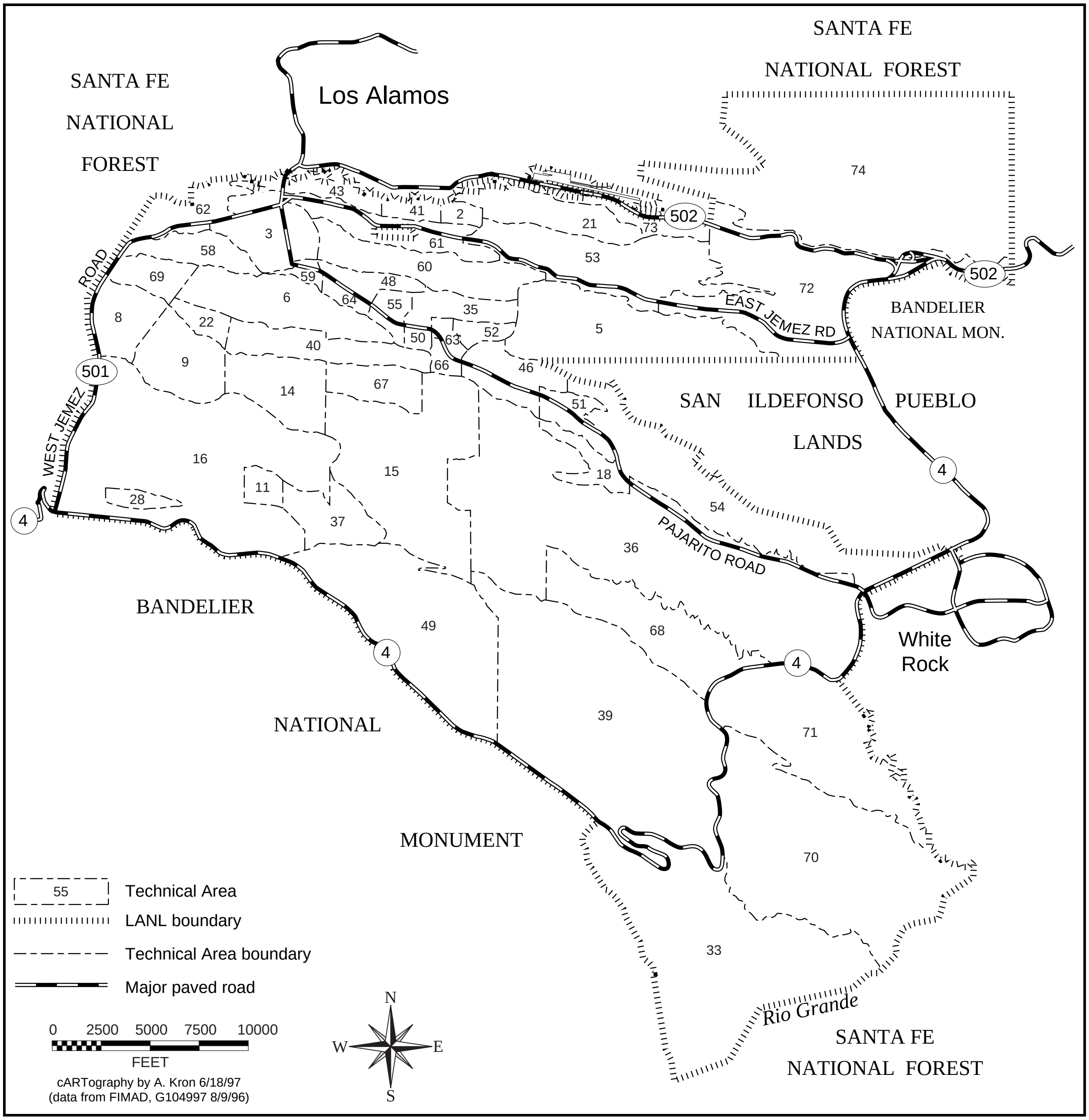


Figure S–18 Technical Areas at LANL

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**.

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

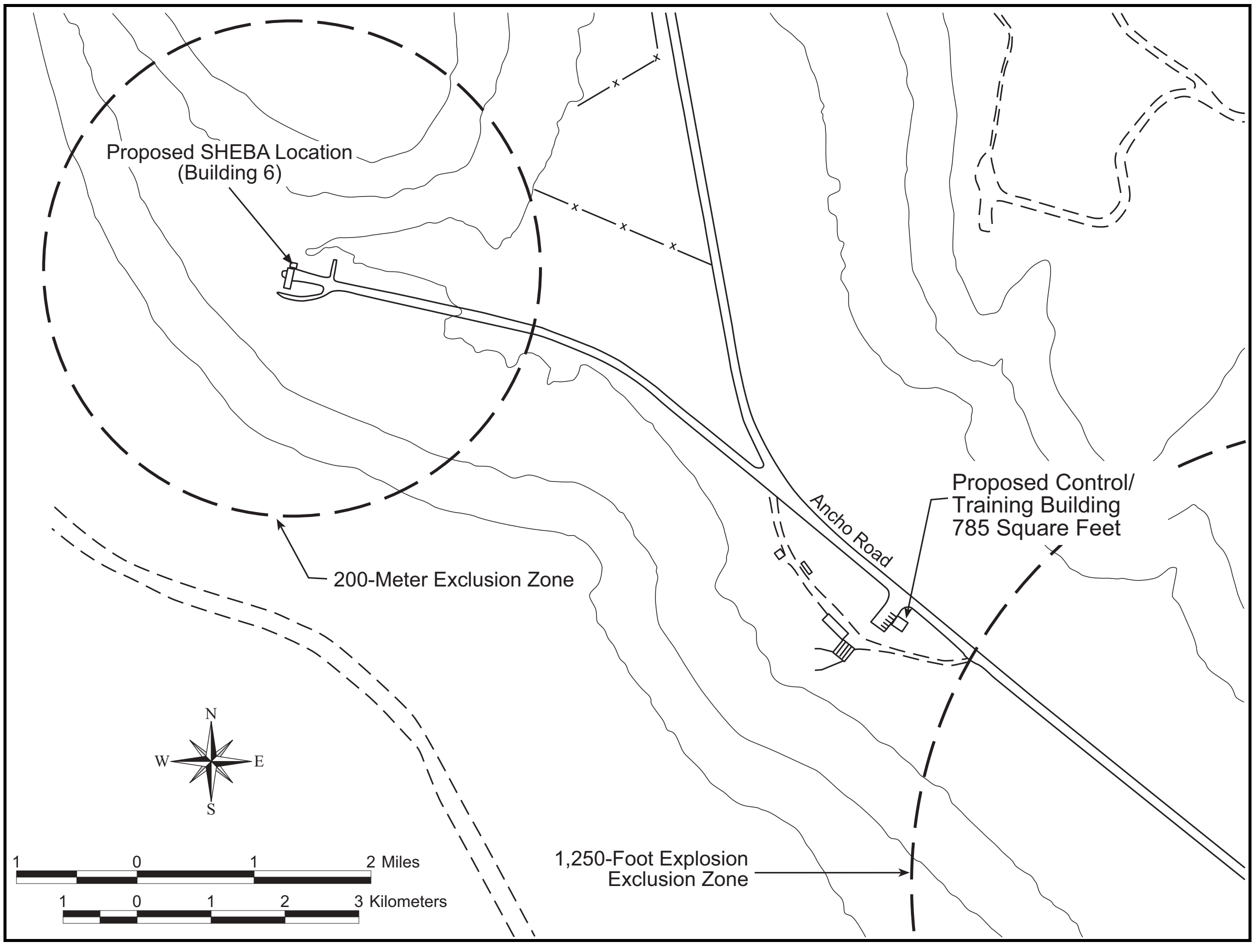


Figure S–19 Location of the Proposed Facilities for the Relocation of SHEBA at LANL's TA-39

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 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.

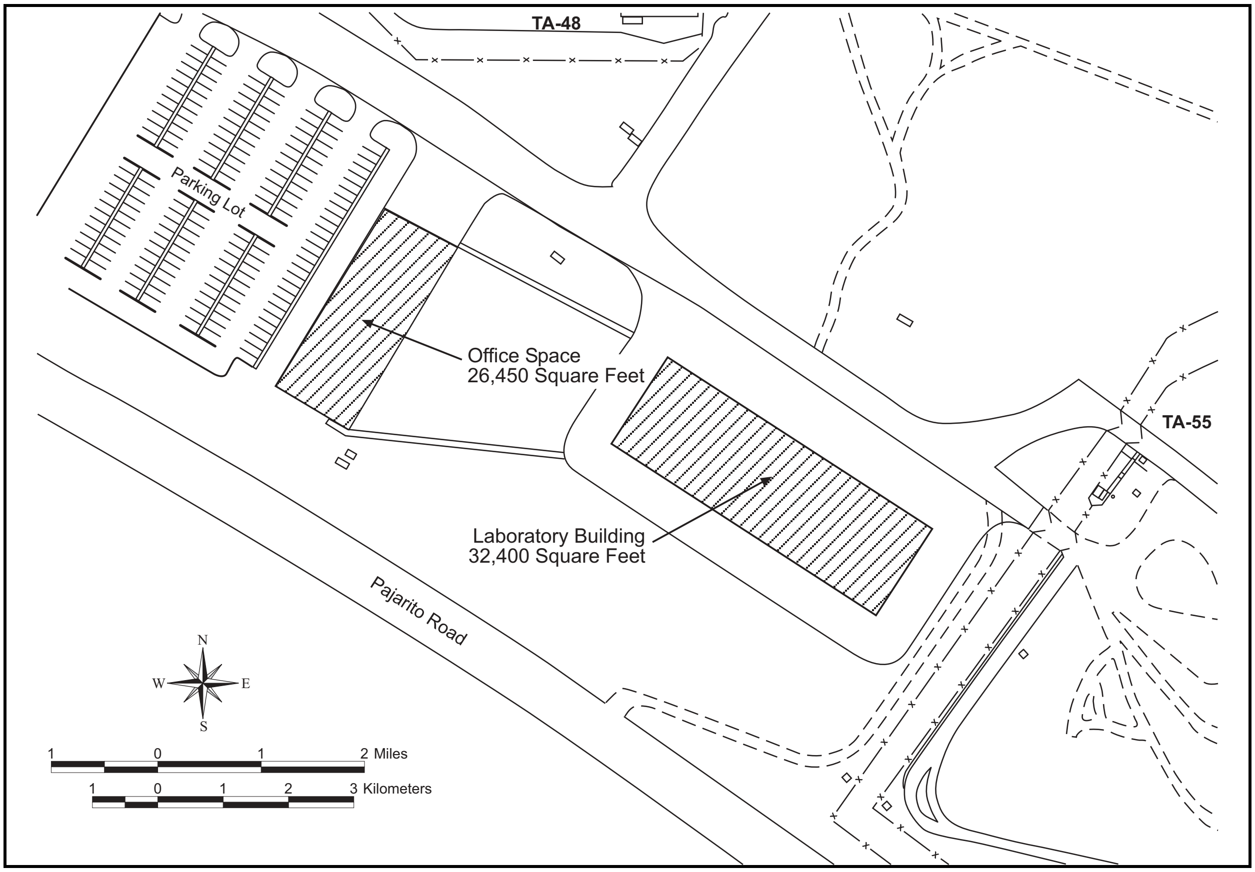


Figure S–20 Location of the Proposed Facilities for the Relocation of Security Category III/IV Activities at LANL's TA-55

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 Cerro Grande Fire), 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 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.

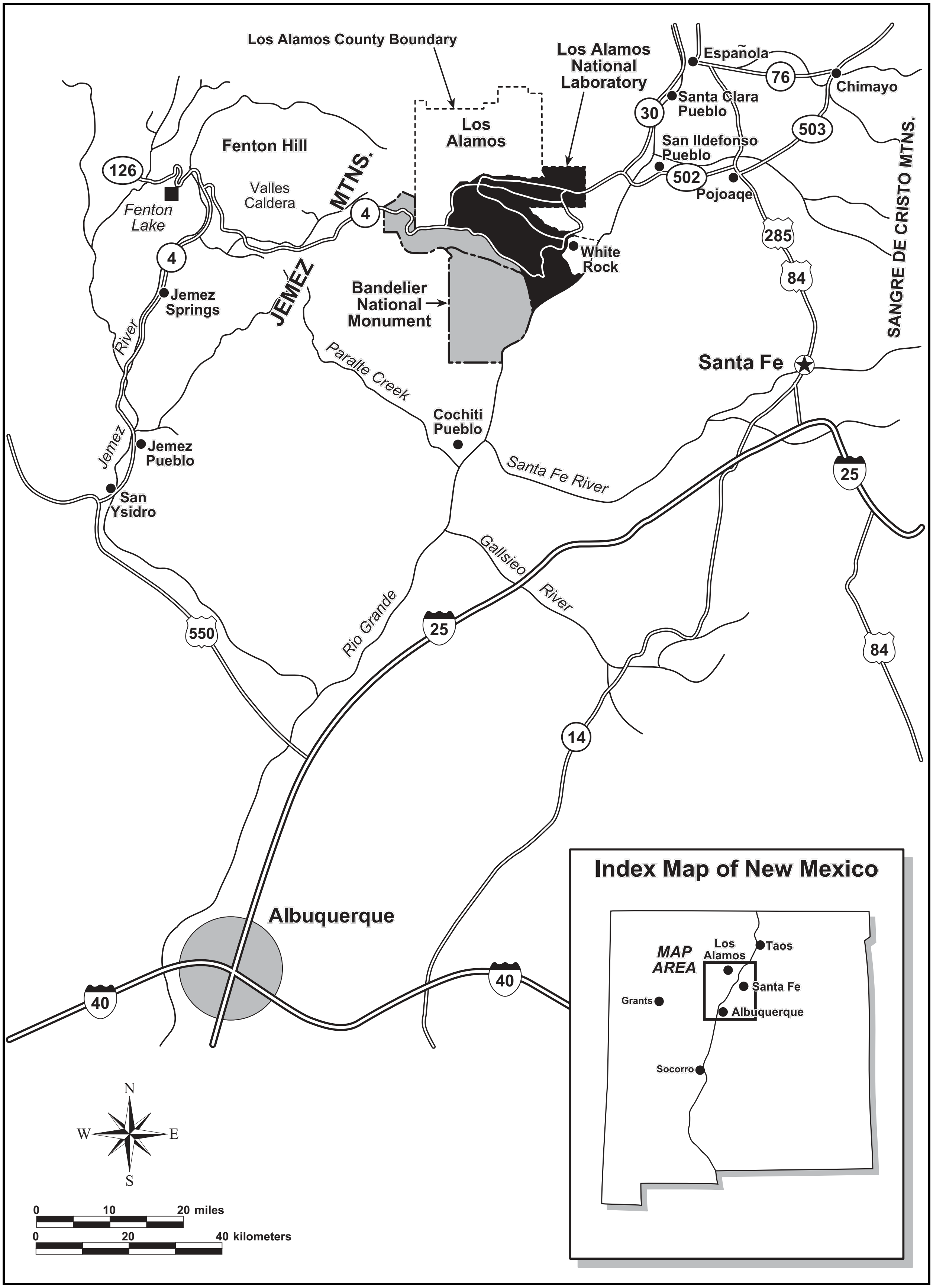


Figure S–21 Location of LANL

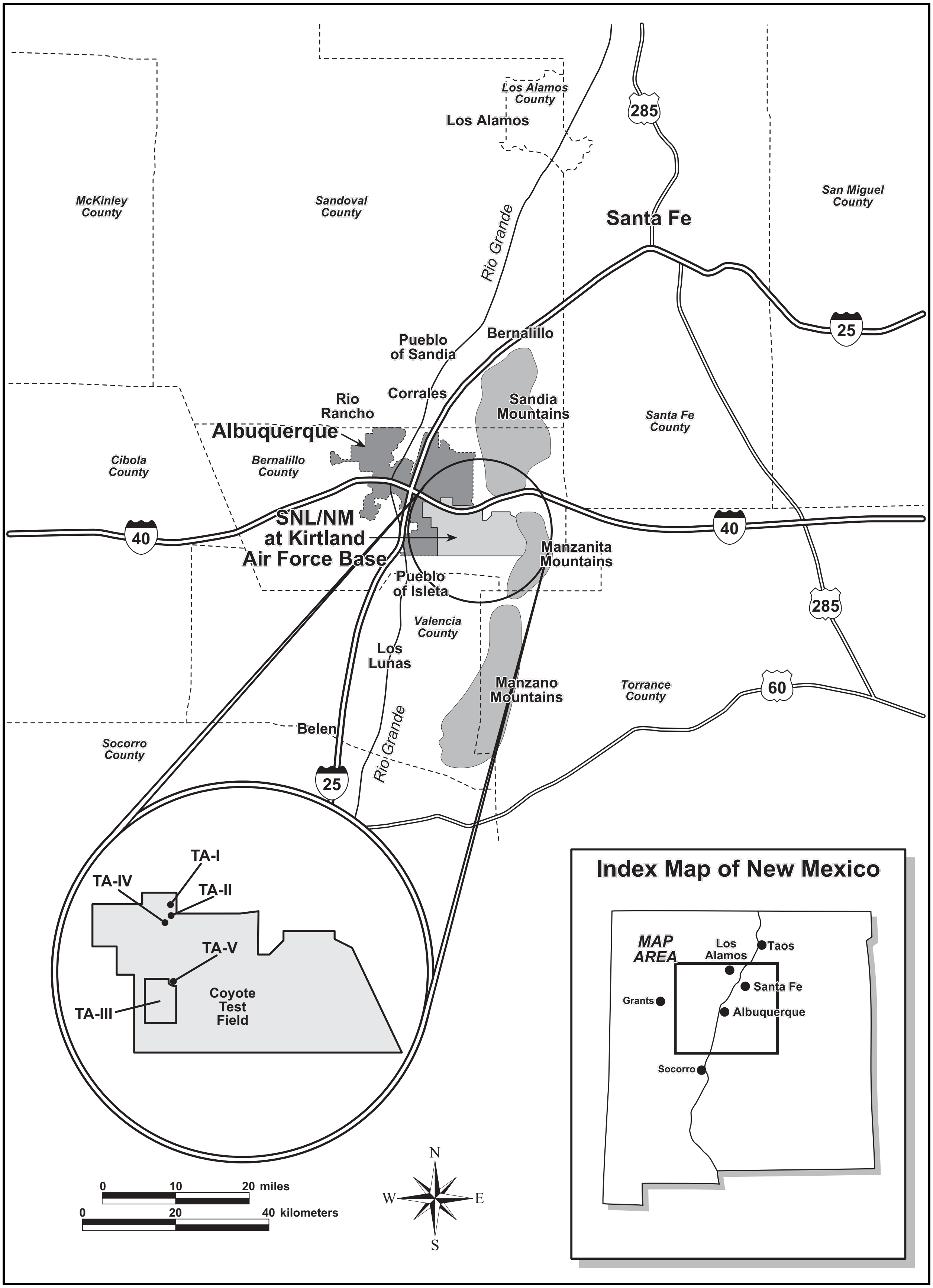


Figure S–22 Location of SNL/NM

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 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).

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

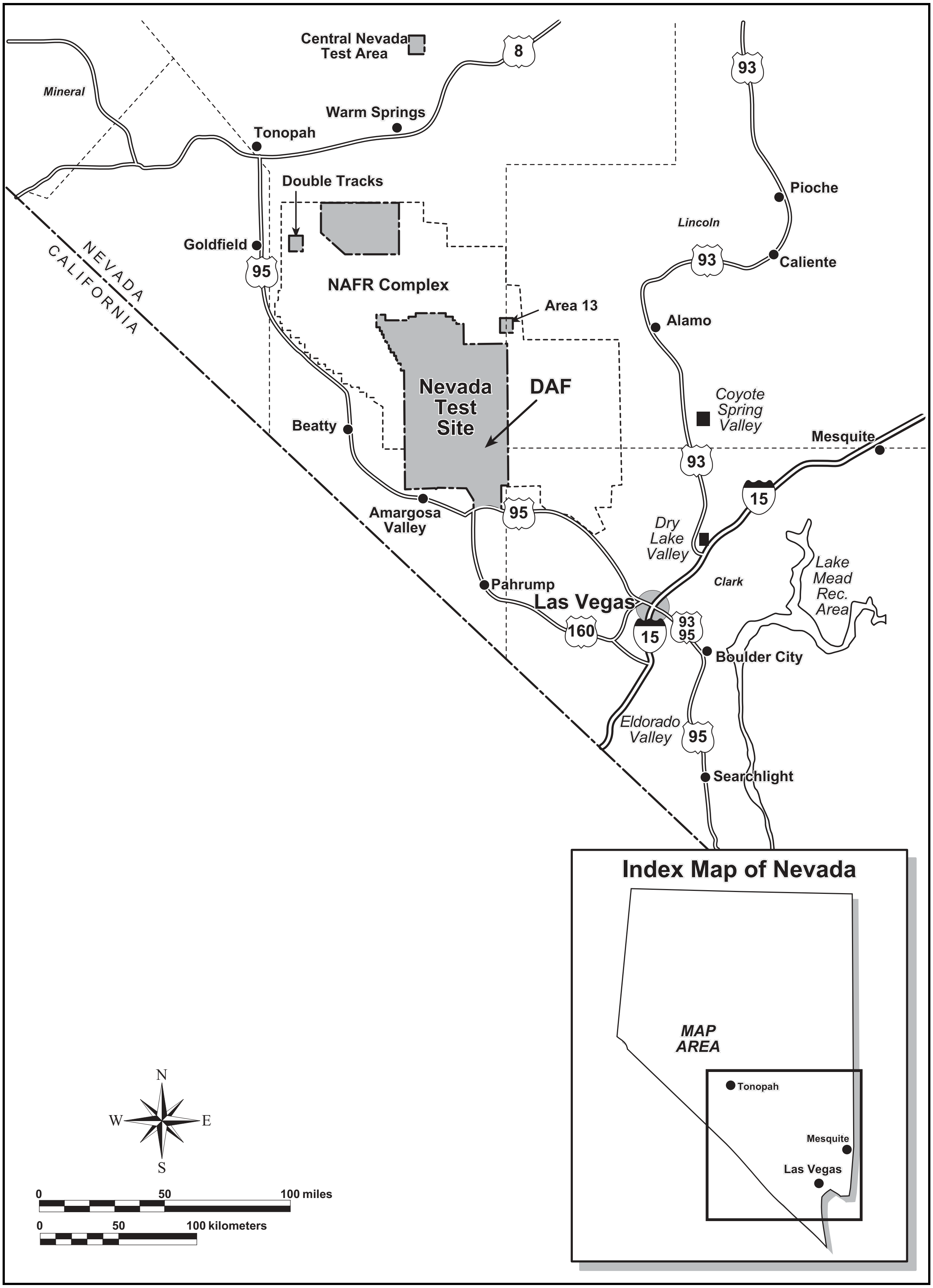


Figure S–23 Location of NTS

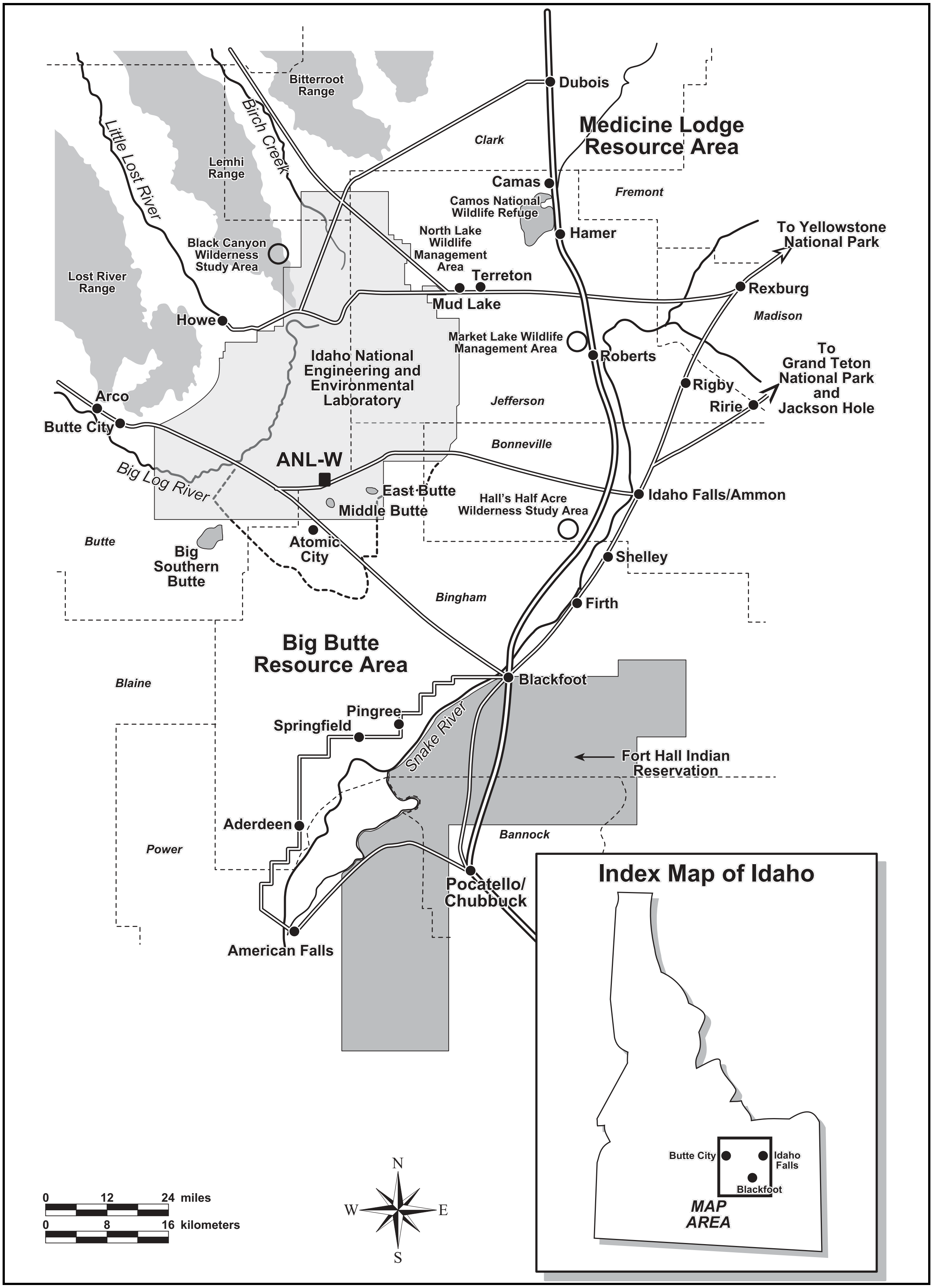


Figure S–24 Location of ANL-W

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

The 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 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). Since publication of the *TA-18 Relocation Draft EIS*, NNSA has conducted additional analyses and has concluded that relocating the security Category I/II activities to NTS is the Preferred Alternative. The conclusion was based on cost; security and mission factors. The Preferred Alternative for SHEBA and other security Category III/IV activities is that those activities remain at TA-18.

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. 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 0.9 hectares (2.2 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.

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.

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 4.9×10^{-5} from a potential hydrogen detonation accident at SHEBA. Statistically, this would equate to 1 additional latent cancer fatality every 20,400 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.

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		0.2 hectares/no impact		1.8 hectares/no impact		1.8 hectares/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	0.000051		0.000051		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]	
0.9 hectares/no impact		0.6 hectares/no impact		0.5 hectares/no impact		1.7 hectares/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 (e.g., 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 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-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 boundary of a DOE Complex site.

on site **—** The term denotes a location or activity occurring within the boundary of a 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, and subject to relocation.

shielding — In regard to radiation, any material of obstruction (e.g., 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 3.1-centimeter (8-inch) thick reinforced concrete; (2) a built-in combination-locked steel door which, for existing structures, is at least 0.39 centimeter (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.