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

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

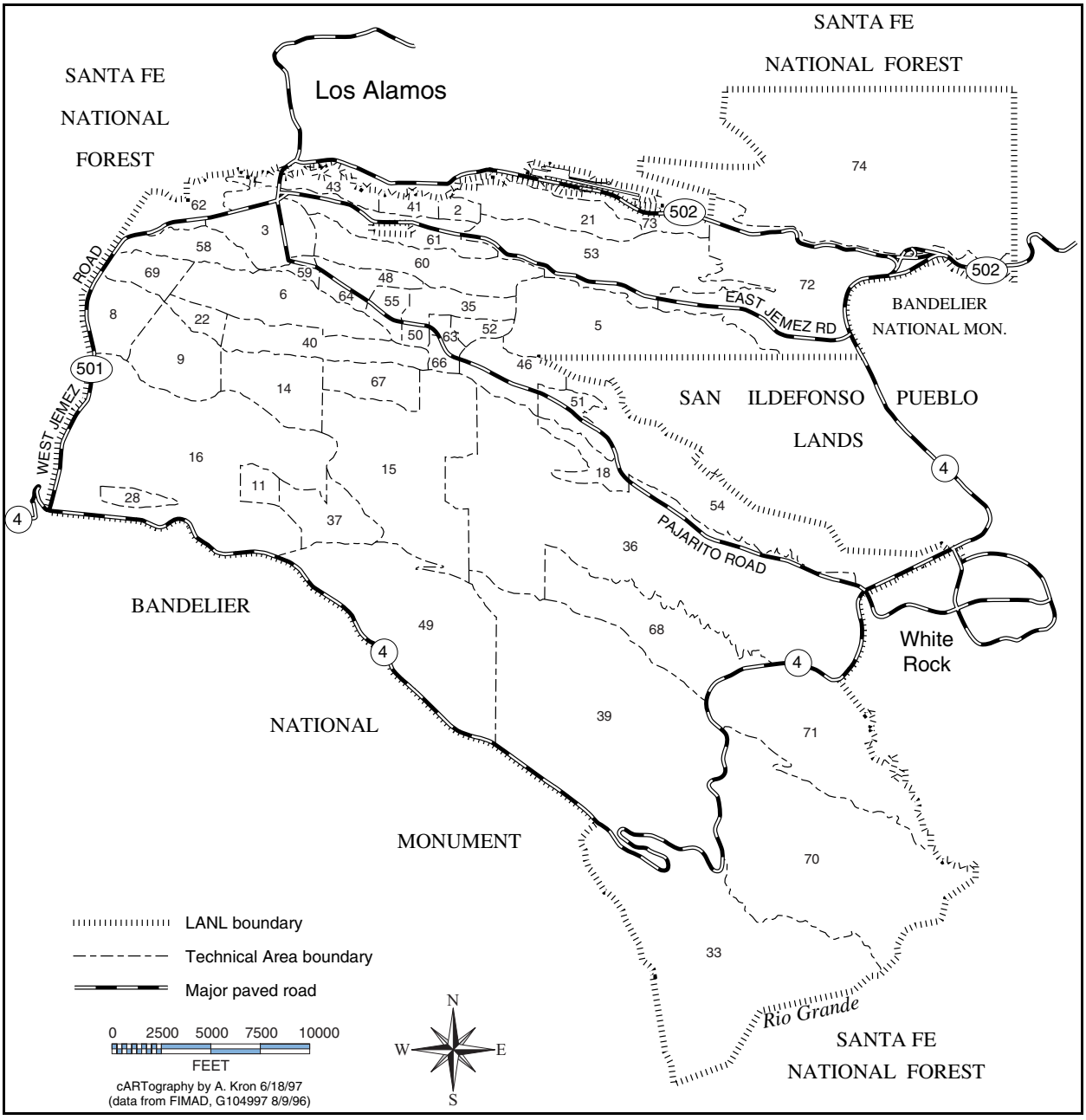

Figure S–18 Technical Areas at LANL

S.3.2.7.1 Siting Selection for SHEBA

SHEBA and other security Category III/IV activities are currently conducted at TA-18. A major distinguishing characteristic of the SHEBA criticality machine is that it is used to test and calibrate criticality

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

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

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

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

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

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

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

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

S.3.2.7.2 Facilities

The relocation of the SHEBA activities to TA-39 would involve the construction of a new structure on top of an existing bunker (Building 6 at TA-39) or the construction of a new bunker and cover structure at another suitable location at TA-39. The bunker, in both cases, would be used to house the SHEBA solution tanks and support equipment. A new control and training-room structure would either be built along the existing road leading to Building 6 at TA-39, or in relatively close proximity to the construction of the new SHEBA bunker. In either case, it would be outside the SHEBA radiation and existing explosives magazines

exclusion zones. Water and gas would be extended to this building, along with the installation of a septic tank and leach field. The location of the existing Building 6 at TA-39 proposed for the relocation of SHEBA is shown in **Figure S–19**.

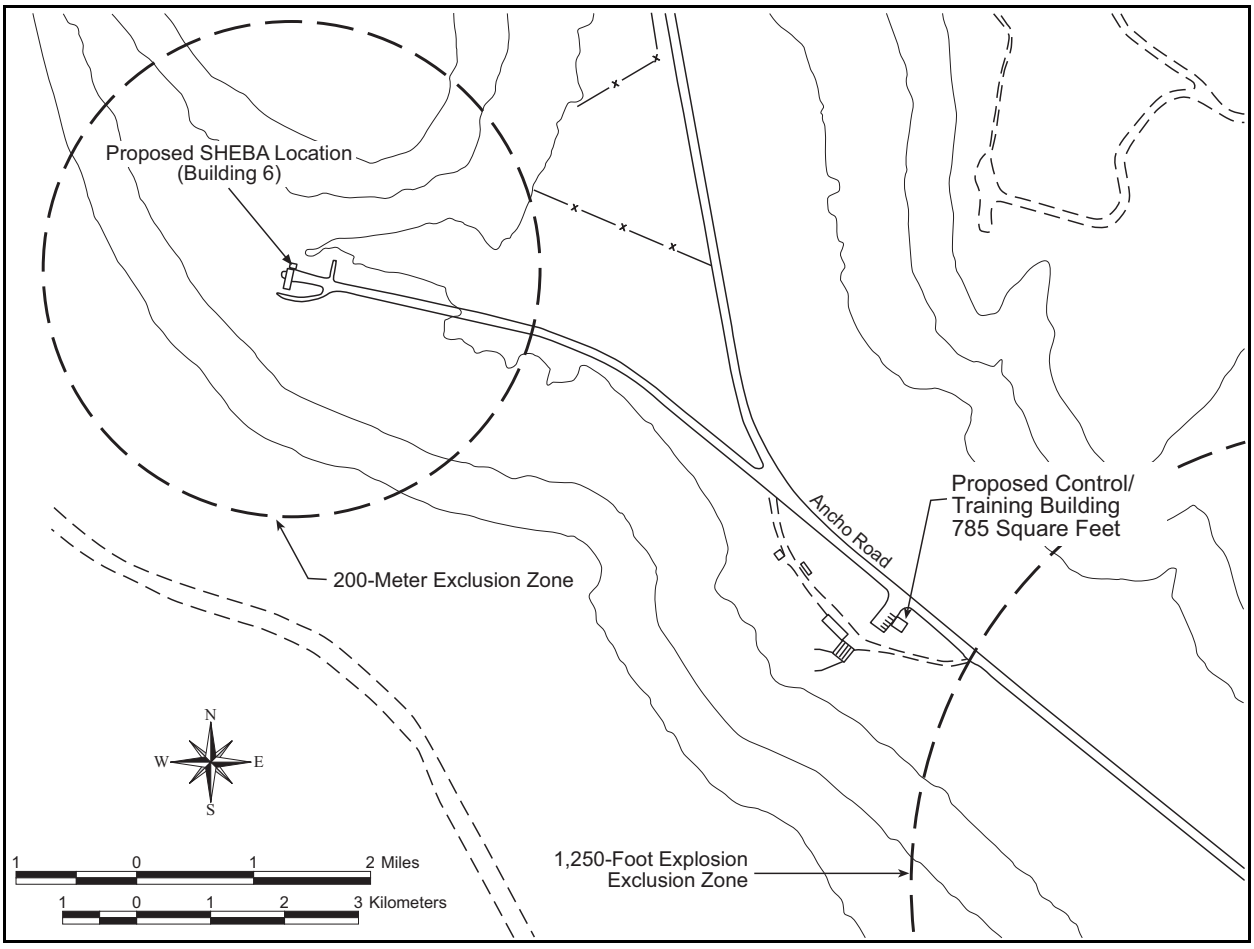

Figure S–19 Location of the Proposed Facilities for the Relocation of SHEBA at LANL's TA-39

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

S.3.3 Alternatives Considered and Dismissed

Discontinue TA-18 Missions

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

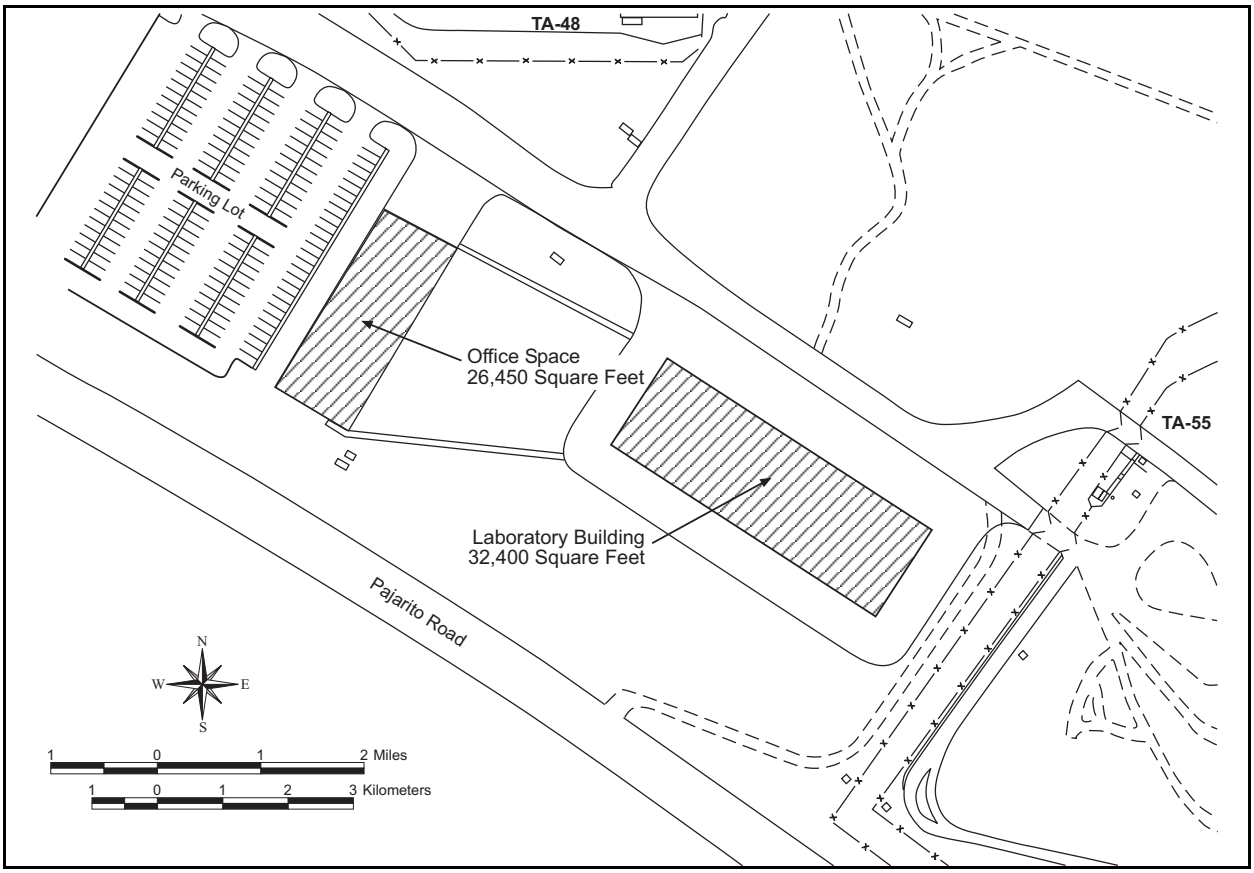

Figure S–20 Location of the Proposed Facilities for the Relocation of Security Category III/IV Activities at LANL's TA-55

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

Alternative Sites

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

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

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

S.4 AFFECTED ENVIRONMENT

Los Alamos National Laboratory

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

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

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

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

Sandia National Laboratories/New Mexico

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

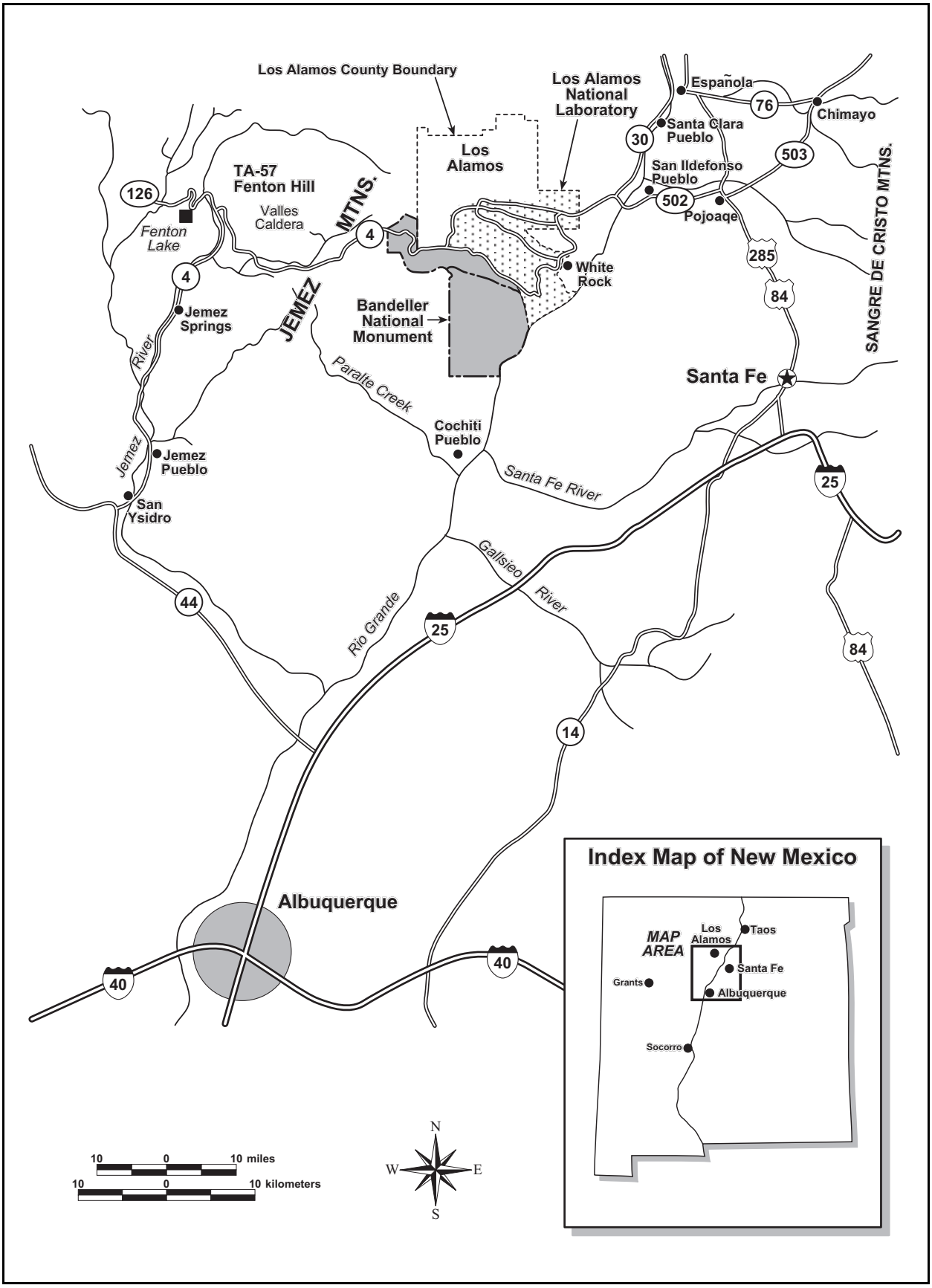

Figure S–21 Location of LANL

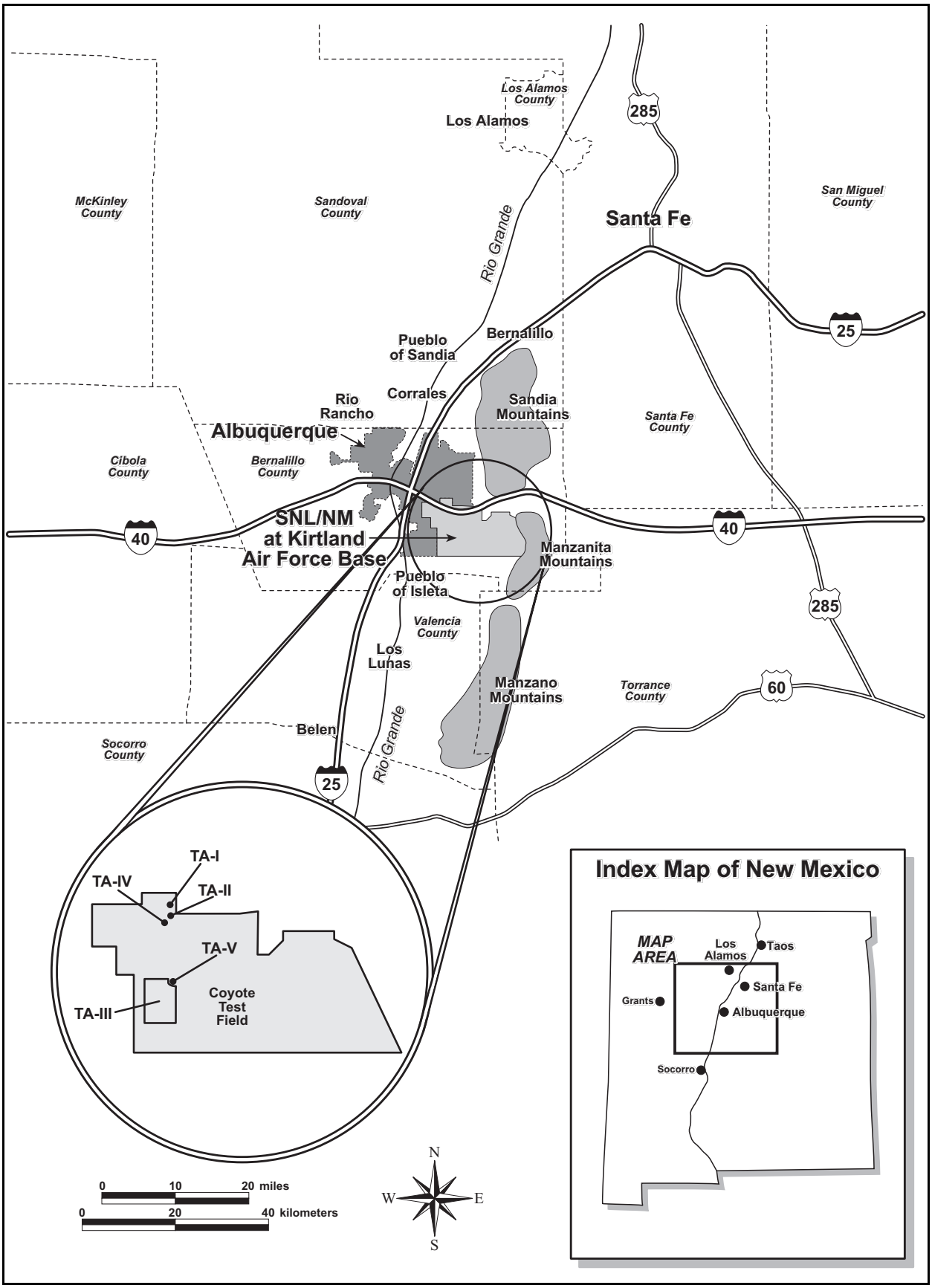

Figure S–22 Location of SNL/NM

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

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

Nevada Test Site

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

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

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

Argonne National Laboratory-West

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

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

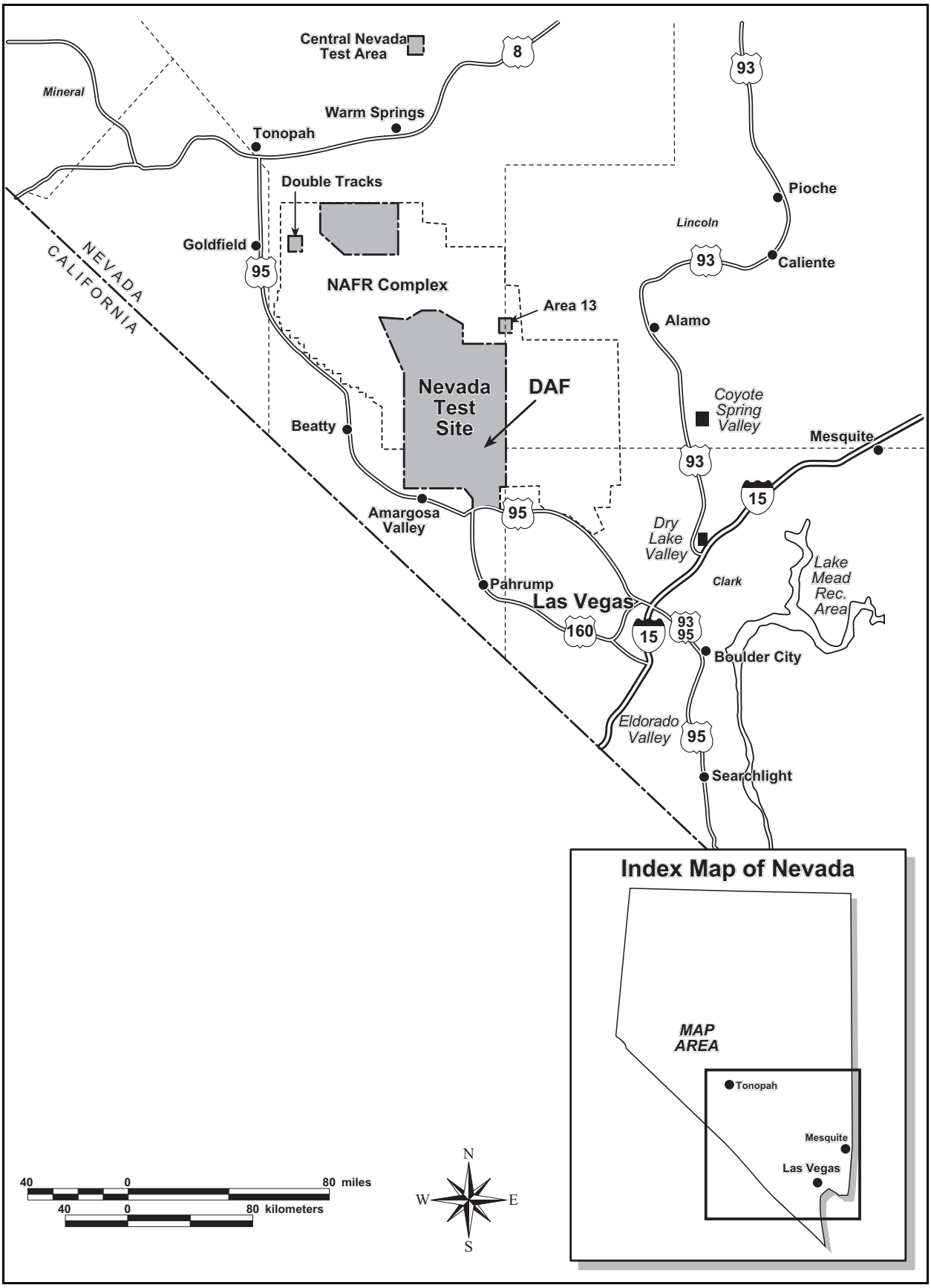

Figure S–23 Location of NTS

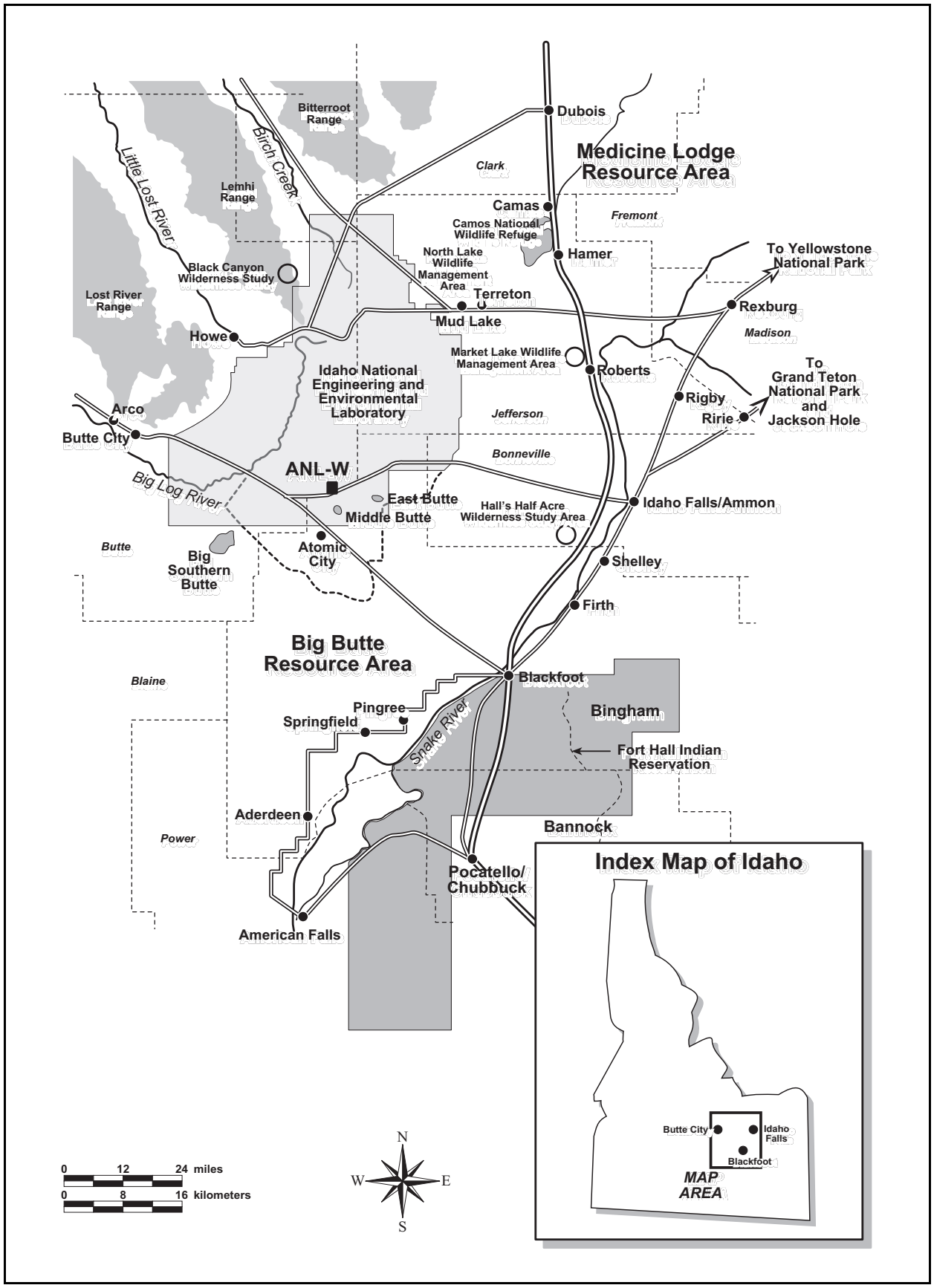

Figure S–24 Location of ANL-W

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

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

S.5 PREFERRED ALTERNATIVE

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

S.6 COMPARISON OF ALTERNATIVES

S.6.1 Introduction

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

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

S.6.2 Construction Impacts

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

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

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

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

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

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

S.6.3 Operations Impacts

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

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

Potential impacts from accidents were estimated using computer modeling. In the event of an accident involving the operational activities, the projected latent cancer fatalities at all relocation sites would be significantly less than 1. For the bounding accident analyzed in the EIS, the highest potential annual risk to the population within 80 kilometers (50 miles) from the TA-18 operations would be an increase in latent cancer fatalities of 5.1×10^{-5} from a potential hydrogen detonation accident at SHEBA. Statistically, this

would equate to 1 additional latent cancer fatality among the affected population every 19,600 years of operation. Overall, the No Action Alternative, and specifically SHEBA operations, would produce the highest potential accident impact, primarily due to the fact that existing TA-18 facilities do not incorporate high-efficiency particulate air filtration, and, in the case of SHEBA, the design provides minimal containment.

S.6.4 Transportation Risks

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

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

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

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

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

Radiological Health Effects Risk Factors Used in the EIS

Health impacts of radiation exposure, whether from sources external or internal to the body, are generally identified as "somatic" (i.e., affecting the exposed individual) or "genetic" (i.e., affecting descendants of the exposed individual). Radiation is more likely to produce somatic effects (e.g., induced cancers) than genetic effects. Except for leukemia, which can have an induction period (time between exposure to carcinogen and cancer diagnosis) of as little as 2 to 7 years, most cancers have an induction period of more than 20 years. Because of the delayed effect, the cancers are referred to as "latent" cancers.

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

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

Examples:

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

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

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

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

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

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

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

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

S.6.6 Impacts Common to All Alternatives

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

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

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

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

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

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

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

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

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

NTS Alternative	*ANL-W Alternative*	*SHEBA Relocation to TA-39* [a]	*Other Security Category III/IV Relocation to TA-55* [a]
1.7 acres/no impact	1.5 acres/no impact	0.2 acres/no impact	4.1 acres/no impact
Small temporary impact	Small temporary impact	Small temporary impact	Small temporary impact
10 curies per year of argon-41 released	10 curies per year of argon-41 released	100 curies per year of argon-41 released	Trace level of radioactivity released
Small temporary impact	Small temporary impact	Small temporary impact	Small temporary impact
Small impact	Small impact	Small impact	Small impact
No noticeable changes; 60 workers (peak)	No noticeable changes; 120 workers (peak)	No noticeable changes; 25 workers (peak)	No noticeable changes; 45 workers (peak)
20 people relocated or new hires	20 people relocated or new hires	No increase in workforce	No increase in workforce

Dose	*LCF*	*Dose*	*LCF*	*Dose*	*LCF*	*Dose*	*LCF*
0.000070	3.5×10^{-8}	0.00041	2.1×10^{-7}	0.087	0.000044	Small	
0.000087	4.4×10^{-11}	0.00021	1.1×10^{-10}	0.061	3.0×10^{-8}	Small	
3.9×10^{-6}	1.9×10^{-12}	1.7×10^{-6}	8.6×10^{-13}	0.00019	1.0×10^{-10}	Small	
10 [b]	0.0040	10 [b]	0.0040	11 [c]	0.0045	Small	
100	0.00004	100	0.00004	100	0.00004	Small	
None		None		None		None	
7.7×10^{-10}		7.7×10^{-9}		4.9×10^{-5}		Small	
2.5×10^{-12}		7.3×10^{-12}		1.4×10^{-7}		Small	
4.0×10^{-9}		7.2×10^{-9}		2.0×10^{-6}		Small	
None							
No disproportionally high and adverse impacts on minority or low-income populations							
145		145		(e)		(e)	
1.5		1.5		(e)		(e)	
4		4		(e)		(e)	
Person-rem	*LCF*	*Person-rem*	*LCF*	*Person-rem*	*LCF*	*Person-rem*	*LCF*
0.33	0.00016	0.39	0.00019	(f)	(f)	(f)	(f)
0.25	0.00010	0.28	0.00011	(f)	(f)	(f)	(f)
0.000028	1.4×10^{-8}	0.000038	1.9×10^{-8}	(f)	(f)	(f)	(f)

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

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

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

S.7 GLOSSARY

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

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

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

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

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

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

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

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

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

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

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

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

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

cell — See *hot cell*.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

system, or component must meet its functional goals; or (3) requirements derived from Federal safety objectives, principles, goals, or requirements.

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

effluent — A gas or fluid discharged into the environment.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

high-level radioactive waste — High-level waste is the highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid

material derived from such liquid waste that contains fission products in sufficient concentrations, and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

nuclear criticality — See *criticality*.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

radioactivity —

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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