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CHAPTER 2

Sandia National Laboratories/New Mexico Operations

Chapter 2 provides an overview of Sandia National Laboratories/New Mexico (SNL/NM) operations, programs, and facilities. It begins with a description of the history of the laboratory and site-wide operations, followed by a discussion of SNL/NM support for U.S. Department of Energy (DOE) mission lines, programs, and projects. Descriptions of selected facilities and their operations are located at the end of the chapter.

During World War II, nuclear weapons were designed, developed, and tested entirely at Los Alamos Laboratory. In late 1945, Los Alamos Laboratory began transferring its field-testing and engineering organization, known as Z-Division, to Sandia Base, near Albuquerque. This organization was the nucleus of what became Sandia Laboratory in 1949. The initial focus of the newly formed Sandia Laboratory was on nuclear weapons engineering and production coordination, with a growing emphasis on research and development (R&D) to improve weapons design.

By 1952, Sandia Laboratory focused on weapons development. The laboratory undertook extensive field testing of components, supported the atmospheric tests conducted by its partner laboratories, and established an advanced development group to anticipate future nuclear weapons proliferation, weapons development, and treaty monitoring technological projects.

In the 1960s and early 1970s, the growing emphasis on strengthening engineering applications resulted in new missions lines and programs. These new areas, energy research and safeguards and security, addressed international concerns such as the energy crisis and international terrorism. They remain as current programs in the areas of nuclear, fossil, and renewable energy.

As international arms control efforts increased in the late 1970s and throughout the 1980s, the U.S. emphasized treaty monitoring, safety, security, and control of the national nuclear weapons stockpile. With the end of the Cold War in the late 1980s, the role of SNL/NM (formerly known as Sandia Laboratory), to act as stockpile steward ensuring nonproliferation and continued safety, security, and reliability, took on greater importance.

The DOE uses management and operating (M&O) contractors to manage its facilities, including SNL/NM. SNL/NM was managed and operated by American Telephone and Telegraph (AT&T) from 1949 to 1993. In 1993, the M&O contract was awarded to Sandia Corporation, a subsidiary of Martin Marietta Corporation, now known as Lockheed Martin Corporation.

2.1 SNL/NM SUPPORT FOR DOE MISSION LINES

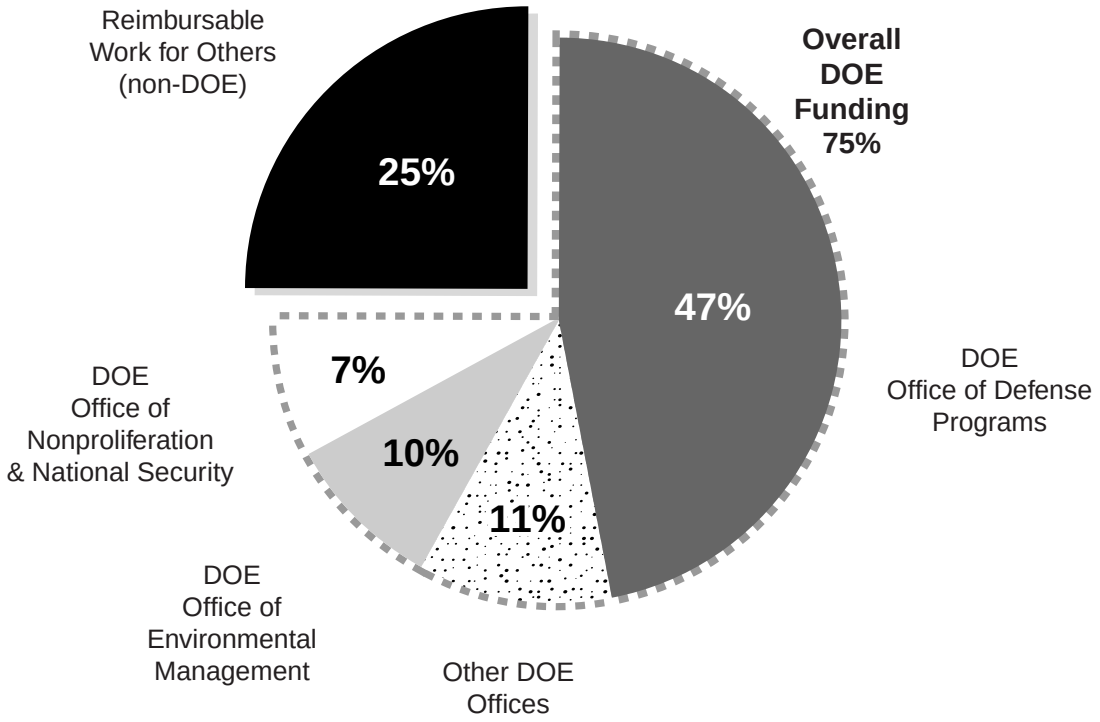
As discussed in Chapter 1, the DOE is responsible for ensuring the safety, reliability, and effectiveness of the nation's nuclear deterrent; fostering a secure and reliable energy system that is environmentally and economically sustainable; reducing the environment, safety, and health risks and impacts from DOE facilities and materials; maintaining leadership in basic research; and advancing scientific knowledge.

SNL/NM has unique capabilities that support the DOE Office of the Assistant Secretary of Defense Programs (DP) and other programs. DP provides approximately 47 percent of SNL/NM's budget (Figure 2.1–1).

SNL/NM conducts R&D activities involving over 90 percent of the individual nonnuclear parts of a typical nuclear weapon.

SNL/NM's primary capabilities, as listed in Chapter 1, are as follows:

- Supporting stockpile surveillance activities of hardened weapons systems and components to ensure these systems function properly when exposed to radiation from hostile sources, whether encountered by satellites and reentry vehicles in space or by the conditions created by nuclear detonations. SNL/NM integrates experimentation and computational simulation in support of radiation effects testing, radiation transport, diagnostics, and analyses to certify that electrical, mechanical, energetic, and other nonnuclear components will operate as designed in such hostile radiation environments.



Source: SNL/NM 1997i

Figure 2.1–1. SNL Funding Sources by Major Program

SNL funding is provided by a variety of major programs.

- Developing specific, limited "piece parts" required to repair deterioration or defects in existing weapons components or to make modifications essential to maintaining deterrent credibility as the existing stockpile continues to shrink and age.
- Characterizing and demonstrating the utility of pulsed-power-generated soft X-ray sources for weapons physics and inertial confinement fusion experiments. SNL/NM combines diagnostics, modeling, and simulation codes in designing, developing, and applying pulsed-power accelerators.
- Developing fundamental capabilities required to take advantage of computational engines ranging from clusters of components to massively parallel units to large state-of-the-art platforms. Expertise ranges from fundamental, broadly applicable efforts to those of a developmental nature, all of which support both high-end computing and specific stockpile systems simulations.
- Conducting computer science research that addresses computational methods and technologies such as numerical methods for designing and processing new stockpile materials, new massively parallel numerical algorithms, and new strategies for code reusability, portability, and debugging. SNL/NM develops codes for simulating shock, high-velocity impact, penetration, or blast, and develops computational techniques that can represent fundamental circumstances and processes with the capability to provide predictive solutions.
- Developing radiation transport models that address three-dimensional radiation deposition for heat-based structure response and heat-based mechanical shock of systems in hostile environments.
- Manufacturing neutron generators, switches, and tubes. SNL/NM provides technical analysis, engineering design, and manufacturing support for nonnuclear components, as well as nonnuclear component dismantlement support.
- Providing sensor development, technical analysis, and export license support for the control and prevention of nuclear and nonnuclear (chemical, biological, explosive, and missiles) proliferation. Detection technology capabilities include airborne, satellite, seismic, and chemical-based monitoring systems.

- Producing a number of medical radioisotopes including iodine-131 and molybdenum-99, the primary isotope used in nuclear medicine in the U.S. SNL/NM supports the development of optimized production and processing, cooperation with private industry, and technology transfer.
- Conducting fundamental energy research in a wide variety of energy resources including electrical energy, energy storage, hydrogen storage (fuel cells), fossil fuels, geothermal technology (wireless telemetry), solar energy technology, photovoltaics (silicon cell), applied wind power technology, and light-water reactor technology.
- Conducting numerous projects that contribute to DOE's science and technology mission. These include activities in scientific computing, basic energy conducting sciences, and magnetic fusion energy; developing methods using computational science research for solving scientific and engineering problems and a software infrastructure for parallel computing; using the performance and cost advantages of massive parallelism to meet critical DOE mission requirements in advanced computing; conducting scientific research, development, and applied engineering on materials and systems in areas of chemistry, physics, material science, biology, and environmental sciences; and designing components for fusion plasma environments.
- Managing, storing, and treating a variety of wastes. SNL/NM also develops technology to improve waste processing and reduce impacts to the environment, including technology applied at long-term waste disposal facilities such as Waste Isolation Pilot Plant (WIPP).
- Restoring, monitoring, and treating a variety of environmental cleanup sites. SNL/NM develops technology (including remote robotics) to improve environmental restoration processes to reduce impacts to the environment.

The DOE directs SNL/NM activities in support of its programs and missions. In turn, SNL/NM's facilities and operations are designed to meet the requirements of the programs, projects, and activities assigned to the laboratory. Figure 2.1–2 illustrates the DOE's funding, by mission, to SNL/NM facilities. Table 2.1–1 lists DOE mission lines by DOE mission and office. Following are brief descriptions of DOE mission assignments to SNL/NM.

2.1.1 SNL/NM Support for DOE's National Security Mission Line

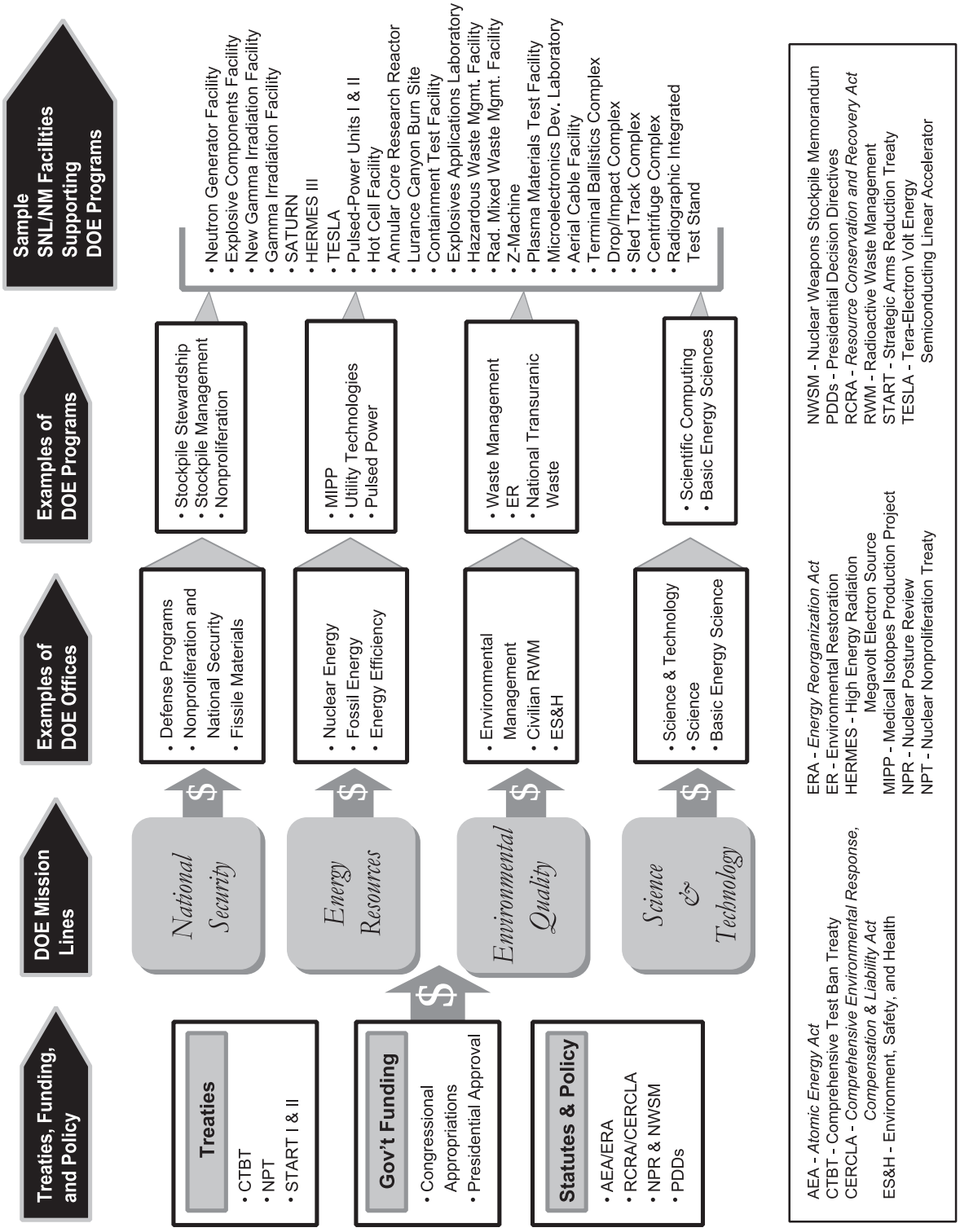
SNL/NM's principal DOE assignments under the National Security mission line focus on the nuclear stockpile and reducing the vulnerability of a reduced stockpile; managing nonnuclear components of nearly every weapon in the U.S. nuclear weapons stockpile; and reducing the vulnerability of the U.S. to threats of proliferation and the use of weapons of mass destruction, to nuclear incidents, and to environmental damage. Following are the major DOE programs under this mission line:

- *Stockpile Stewardship*—Tasks involve stockpile upgrades, material and component tests involving hostile environmental exposures, computer-simulated testing, performance assessments, systems component engineering, chemistry and material science activities, stockpile computations, pulsed-power-driven inertial confinement research, and new technology development.
- *Stockpile Management*—SNL/NM provides capabilities in onsite and offsite manufacturing; design of nonnuclear components, systems, and materials; production support; quality assurance; stockpile surveillance; component dismantlement; and accident response support. SNL/NM supplies, certifies, and tests shipping containers including nuclear component and tritium containers.
- *Nonproliferation*—Material control includes support in the following areas: verification R&D; nuclear safeguards and security; arms control; material protection, control, and accounting; proliferation prevention; and intelligence.

In 1997, SNL/NM undertook 218 R&D projects using DOE-focused technologies and unique SNL/NM science and engineering capabilities (SNL 1998a). Nearly 46 percent of the projects had applications that were national security-related.

2.1.2 SNL/NM Support for DOE's Energy Resources Mission Line

SNL/NM supports DOE assignments under the Energy Resources mission line to enhance the safety, security, and reliability of energy supplies. This work focuses on implications for our nation's security related to the increasing interdependencies among domestic elements and global resources. SNL/NM helps develop strategies to protect the supply of the nation's energy resources. SNL/NM applies science and technology capabilities to develop various



Source: Original

Figure 2.1–2. Flow of DOE Funding by Mission Line to SNL/NM

The DOE's funding flows through various DOE offices to SNL/NM.

Table 2.1–1. DOE Mission Lines and DOE Office Mission Statements

DOE MISSION LINE	DOE OFFICE	MISSION STATEMENT
National Security	Defense Programs	To ensure the safety, reliability, and performance of nuclear weapons without underground testing
	Nonproliferation & National Security	To support DOE activities related to nonproliferation, nuclear safeguards and security, classification and declassification, and emergency management
	Fissile Materials Disposition	To reduce the global nuclear danger associated with inventories of surplus weapons usable fissile materials
Energy Resources	Nuclear Energy	To support the successful decontamination and decommissioning of nuclear reactor sites; certify next-generation nuclear power plants; ensure the availability of industrial and medical isotopes and radioisotope power systems for space exploration
	Fossil Energy	To enhance U.S. economic and energy security
	Energy Efficiency	To lead the nation to a stronger economy, a cleaner environment, and more secure future through development and deployment of sustainable energy technologies
Environmental Quality	Environmental Management	To develop a clear national cleanup strategy with a strong commitment to results that will gain the trust and confidence of Congress, the states, Native American tribes, and the public
	Civilian Radioactive Waste Management	To develop, construct, and operate a system for spent nuclear fuel and high-level radioactive waste disposal, including a permanent geologic repository, interim storage capability, and transportation system
	Environment, Safety, & Health	To protect the environment and the health and safety of workers at DOE facilities and the public
Science & Technology	Science & Technology	To manage and direct targeted basic research and focused, solution-oriented technology development
	Science	To improve and advance the science and technology foundations and effective use and management of DOE laboratories
	Basic Energy Science	To advance the scientific and technical knowledge and skills needed to develop and use new and existing energy resources in an economically viable and environmentally sound manner

Source: DOE 1997c

technologies. Following are the major DOE programs under this mission line:

- *Medical Isotopes Production*—Tasks include developing a U.S. source for the molybdenum-99 isotope and other isotopes that have widespread medical applications. The project uses the Annular Core Research Reactor (ACRR) and the Hot Cell Facility (HCF). Detailed information is provided in the *Medical Isotopes Production Project: Molybdenum-99 and Related Isotopes Environmental Impact Statement* (DOE 1996b).
- *Utility Technologies*—Utility technologies support includes developing clean, renewable, and more economical sources of electricity. SNL/NM supports aggressive R&D in photovoltaic, solar thermal, wind, geothermal, hydropower, and biomass power technologies and systems.
- *Pulsed-Power*—Pulsed-power tasks include developing fusion capabilities and experimenting with X-ray sources for understanding harsh electromagnetic, shock, and debris environments. SNL/NM supports R&D in radiography and accelerator technology.

Of the 218 R&D projects undertaken by the DOE in 1997, about 16 percent had applications that were energy resource-related.

2.1.3 SNL/NM Support for DOE's Environmental Quality Mission Line

SNL/NM supports DOE assignments under the Environmental Quality mission line with onsite waste operations and developing technology, (for example, transuranic [TRU] waste containers) for national environmental problems. Activities include some treatment, temporary storage, and offsite disposal of hazardous waste, low-level waste (LLW), low-level mixed waste (LLMW), TRU, mixed transuranic (MTRU) waste, and solid wastes generated by ongoing mission-related activities. Environmental restoration activities are ongoing at SNL/NM, with most remedial actions scheduled for completion by the end of 2004. Following are the major DOE programs under this mission line:

- *Waste Management*—Tasks include some treatment, storage, and offsite disposal of wastes in a manner that is safe to humans and the environment. The Hazardous Waste Management Facility (HWMF) and Radioactive and Mixed Waste Management Facility (RMWMF) manage a variety of wastes in accordance with applicable laws, permits, and regulations.
- *Environmental Restoration*—Environmental restoration activities include the assessing and cleaning up of inactive sites contaminated from previous defense and nondefense-related programs. SNL/NM activities are conducted in accordance with applicable Federal, state, and local laws and regulations.
- *National TRU Waste Program*—Activities include site assessments, performance assessments, regulatory compliance support, and science research in support of the WIPP.

Of the 218 R&D projects undertaken by the DOE in 1997, about 24 percent had applications that were environmental quality-related.

2.1.4 SNL/NM Support for DOE's Science and Technology Mission Line

SNL/NM's facilities and expertise are used in support of the Science and Technology mission line through R&D in modeling and simulation testing, physical sciences, and advanced chemical and materials sciences. SNL/NM activities include developing radiation-hardened microelectronic components; computer-based testing, modeling, and simulation; and pulsed-power technology. Following are the major DOE programs under this mission line:

- *Scientific Computing*—Advanced mathematical modeling, computational R&D, communication sciences, and information technologies.
- *Basic Energy Sciences*—R&D in material sciences, chemical sciences, energy biosciences, and engineering.

Of the 218 R&D projects undertaken by the DOE in 1997, about 15 percent had applications that were science and technology-related.

2.2 REIMBURSABLE WORK FOR OTHERS

SNL/NM performs reimbursable work for other Federal agencies and sponsors, including the private sector. This work, also known as work for others (WFO), must be compatible with the DOE mission work conducted at SNL/NM and must be work that cannot reasonably be performed by the public sector. Approximately 25 percent of SNL's funding comes from

reimbursable work for agencies and organizations other than the DOE (Figure 2.1–1). SNL/NM activities support other Federal departments and agencies. The major agencies include the U.S. Department of Defense, U.S. Nuclear Regulatory Commission, U.S. Department of Transportation (DOT), National Aeronautics and Space Administration, Department of State, and U.S. Environmental Protection Agency (EPA). Details regarding WFO support activities and projects are provided in SNL/NM's *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b), and the *SNL Institutional Plan FY 1998-2003* (SNL 1997b).

Universities and approved researchers can use SNL/NM facilities to conduct research. SNL/NM collaborates with the University of New Mexico in the materials science area.

2.3 SNL/NM FACILITIES: A FRAMEWORK FOR IMPACTS ANALYSIS

As discussed above, SNL/NM provides a diverse set of capabilities that support DOE's mission lines through various programs. The major consideration in deciding to analyze impacts by facility rather than by program was the complexity of the analysis. Any given program may use operations in more than one facility, and many facilities serve multiple programs. An analysis of environmental impacts requires knowledge of particular activities in a particular place over a known span of time in order to project the effect those activities will have on the surrounding environment. A presentation of impacts by program would require that impacts from operations at each facility be subdivided into the contribution from each program using the facility. The resulting impacts would then have to be reassembled by program. The complexity of analysis would greatly increase, and the clarity of the presentation would suffer. Therefore, the DOE chose to group the operations to be analyzed by facility.

To accomplish this objective, the DOE used the results of a detailed survey distributed throughout SNL/NM to develop a database containing pertinent information about the approximately 670 buildings in the 5 technical areas (TAs) and the structures in the Coyote Test Field. An initial screen of these facilities, along with the details of how the screen was performed, is described and the facilities are listed in the FSID (SNL/NM 1997b).

This list was then further assessed and refined by qualitatively evaluating the types of operations performed, identifying those with the highest potential for environmental impacts or concerns, and then grouping them according to function and location. Key qualitative criteria used in the final screen identified facilities or facility groups with operations that have generated important public concern in the past or have a relatively greater impact to the environment, safety, and health. The criteria used in this final screening process are described in Section 2.3.1 and illustrated in Figure 2.3–1.

The operations within these facilities or facility groups are the basis for differentiating among the three alternatives analyzed in the SWEIS and any associated environmental impacts. Taken together, these facilities and facility groups represent the majority of exposure risks associated with continuing operations at SNL/NM. They represent

- over 99 percent of all radiation doses to SNL/NM personnel.
- over 99 percent of all radiation doses to the public.
- from 81 to 99 percent of stationary source criteria pollutants (nitrogen dioxide, carbon monoxide, particulate matter less than 10 microns in diameter [PM_{10}], and sulfur dioxide), depending on the alternative. This does not include hazardous air pollutants or toxic air pollutants, which instead are analyzed on a site-wide basis in the SWEIS. The remaining stationary source criteria pollutants would be associated with backup generators.
- all waste volumes, including radioactive wastes, Environmental Restoration (ER) Project wastes, and hazardous wastes, which are accounted for in analyses of infrastructure, radiological air quality, transportation, and waste generation.

2.3.1 Facility Screening Process

To be selected for detailed analysis, a facility or facility group had to meet one or more of the following criteria:

- be known to have generated an important public concern;
- conduct operations that have the potential to affect the environment, safety, and health;
- be a critical element of one of SNL/NM's principal missions; and/or
- be anticipated to expand over the next 10 years, likely resulting in the need for additional *National Environmental Policy Act* (NEPA) documentation.

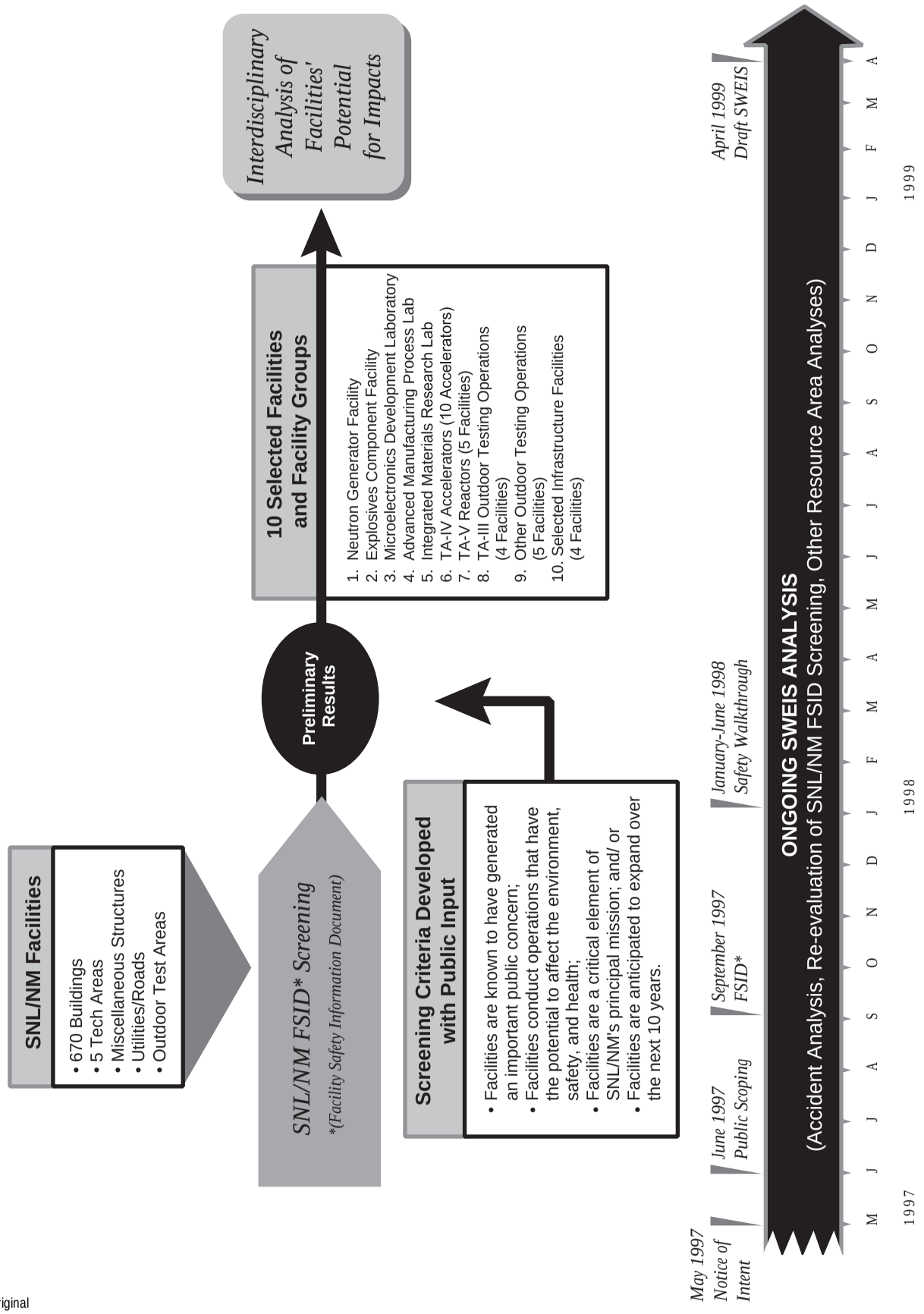


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Figure 2.3–1. SWEIS Analysis of SNL/NM Facilities

An SNL/NM facility screening process was used during SWEIS analysis of potential impacts.

2.3.2 Framework for Analysis

The SWEIS evaluates SNL/NM facilities and operations and their effects on environmental conditions under the three alternatives. Because of their importance, potential environmental impacts from the selected facilities are described and evaluated in greater detail than other SNL/NM facilities. This in-depth look at selected facilities provides the framework for analyzing impacts.

For completeness of analysis, the DOE also gathered information on the balance of operations at SNL/NM. Information regarding other facilities, site support services, water and utility use, waste generation, hazardous chemicals purchased for use, process wastewater, and radioactive dose data were incorporated into the analysis. The DOE examined all nuclear/radiological facilities and hazardous nonradiological facilities and associated DOE-approved safety documents (for example, safety analysis reports, safety assessments, and hazard assessments) for SNL/NM facilities. In addition, facility walk-throughs and interviews were performed to ensure that all hazards and safety concerns were properly captured in the accident analysis. This information is included in the current environmental consequences (Chapter 5) and Appendix F. In addition, some aspects of the impact analysis considered individual facility operations, regardless of whether the entirety of the facility met the criteria for detailed analysis. These aspects included evaluating chemical air emissions and radiological air emissions. This type of specific information, as well the contribution to impacts in all resource areas from the balance of operations at SNL/NM, including ongoing R&D activities, is included in the analysis of each alternative.

The following sections provide an overview of the TAs at SNL/NM and describe the facilities the DOE identified for detailed analysis.

2.3.3 Technical Areas

DOE mission lines are executed at SNL/NM through program funding at multiple facilities. Facility operations are conducted within five TAs and many additional outdoor test areas, including an area of test facilities known as the Coyote Test Field. These TAs comprise the basic geographic configuration of SNL/NM. Figure 2.3–2 shows the locations of the five TAs. 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 (ECF), several active and inactive waste management facilities, and vacated facilities replaced by the ECF. 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 primarily for outdoor testing. A complete listing of all the facilities in each TA is presented in the FSID (SNL/NM 1997b).

2.3.4 Selected SWEIS Facilities

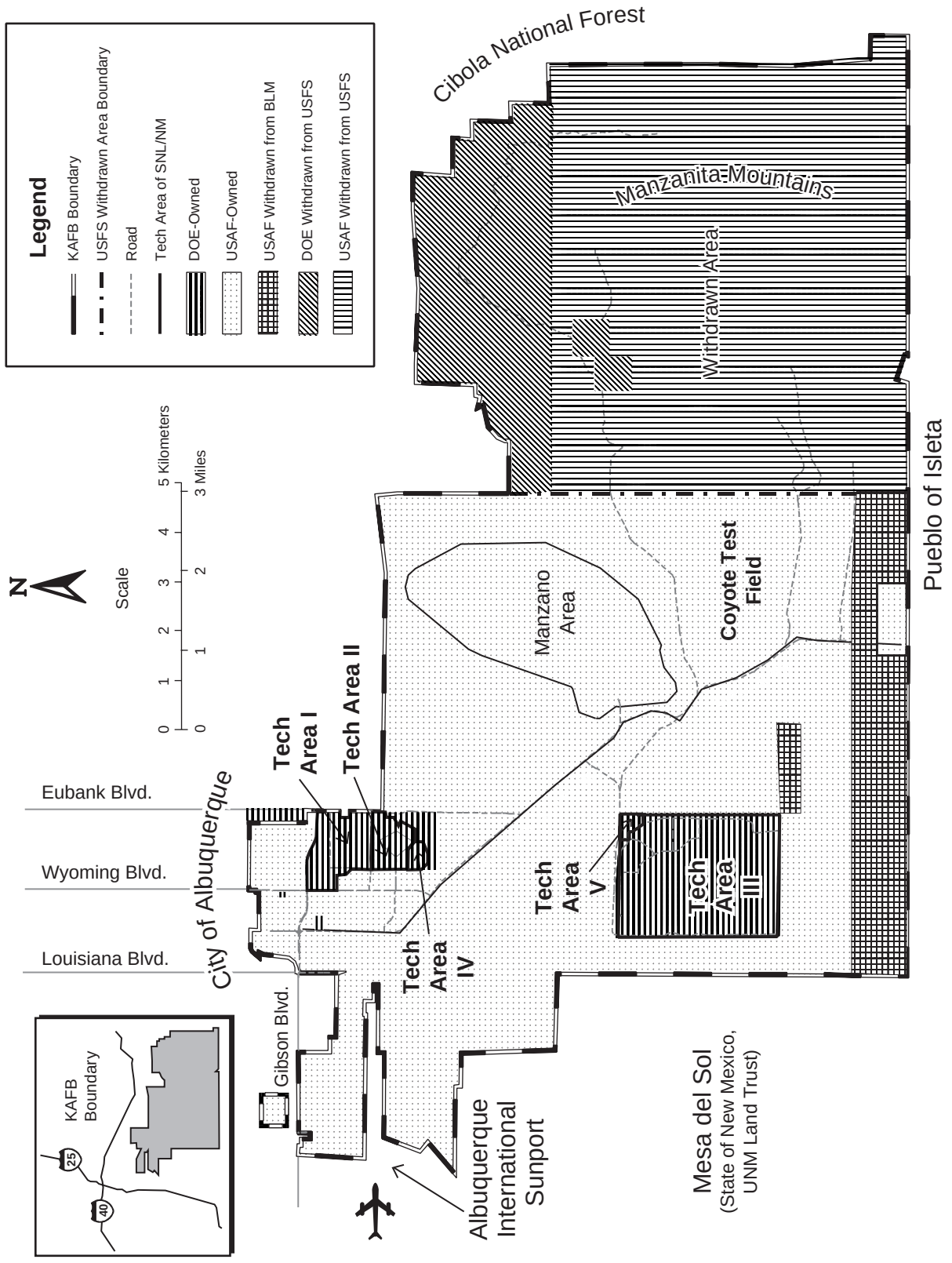
Table 2.3–1 identifies the 10 facilities or facility groups selected for in-depth analysis. Taken together, these facilities represent the main activities at SNL/NM that have the potential to affect the environment, have generated public concern, are critical to SNL/NM's missions, or are anticipated to expand over the next 10 years. TA-I and TA-II contain five selected facilities that fall into the categories of manufacturing, R&D laboratories, and testing described in Section 2.3.4.1, below. The five other selected facility groups include the following:

- physical testing and simulation facilities (TA-III) (Section 2.3.4.2),

Table 2.3–1. Facilities/Facility Groups Selected for Analyzing SNL/NM Operations

SELECTED FACILITIES/FACILITY GROUPS	LOCATION
1. Neutron Generator Facility	TA-I
2. Microelectronics Development Laboratory[a]	TA-I
3. Advanced Manufacturing Processes Laboratory	TA-I
4. Integrated Materials Research Laboratory	TA-I
5. Explosive Components Facility	TA-II
6. Physical Testing and Simulation Facilities	TA-III
7. Accelerator Facilities	TA-IV
8. Reactor Facilities	TA-V
9. Outdoor Test Facilities	Coyote Test Field and Withdrawn Area
10. Selected Infrastructure	TA-I and TA-III

Source: SNL/NM 1997b
TA: technical area
[a] Under the Expanded Operations Alternative, the Microelectronics Development Laboratory could become part of the Microsystems and Engineering Sciences Applications Complex.



Source: SNL/NM 1997j

Figure 2.3–2. Locations of Technical Areas and Outdoor Test Facilities on Kirtland Air Force Base

SNL/NM conducts operations within five technical areas and several outdoor test areas, including the Coyote Test Field.

- accelerator facilities (TA-IV) (Section 2.3.4.3),
- reactor facilities (TA-V) (Section 2.3.4.4),
- outdoor test facilities (including Coyote Test Field and the Withdrawn Area) (Section 2.3.4.5), and
- selected infrastructure facilities (Section 2.3.4.6).

2.3.4.1 Manufacturing, R&D Laboratories, and Testing Facilities

The five selected facilities located in TA-I and TA-II are described below (SNL/NM 1997b).

- *Neutron Generator Facility (NGF)*—Manufactures neutron generators, which provide a controlled source of neutrons.
- *Microelectronics Development Laboratory (MDL)*—Performs R&D and fabricates custom and radiation-hardened microelectronics. Under the Microsystems and Engineering Sciences Applications (MESA) Complex configuration for the Expanded Operations Alternative, the MESA Complex, a proposed state-of-the-art facility, could provide a unique capability in research and development of microsystems-based components in limited quantities as needed to support planned weapon refurbishments. The MESA Complex (a developing proposal) would enhance current MDL capabilities in the areas of micromachines, microsensors, photonics, and microelectronics, including silicon and compound semiconductors (such as alloys of gallium arsenide and indium arsenide). See Facility Descriptions at the end of Chapter 2 for additional information on the MESA Complex.
- *Advanced Manufacturing Processes Laboratory (AMPL)*—Performs R&D of technologies, practices, and unique equipment and fabricates prototype hardware for advanced manufacturing processes.
- *Integrated Materials Research Laboratory (IMRL)*—Performs R&D of semiconducting and other specialized materials, including silicon processing and equipment development and materials synthesis, growth, processing, and diagnostics.
- *Explosive Components Facility (ECF)*—Performs R&D and testing of explosives components, neutron generators, batteries, and explosives.

2.3.4.2 Physical Testing and Simulation Facilities

TA-III is composed of numerous principal buildings and structures devoted to the physical testing and simulation of a variety of natural and induced environments. The facilities include extensive environmental test facilities, such as sled tracks, centrifuges, and a radiant heat facility. Other facilities include an inactive paper incinerator; a large melt facility; and the formerly used Chemical Waste, LLW, and LLMW landfills. Major outdoor operations located in TA-III include the following (SNL/NM 1997b):

- *Terminal Ballistics Complex*—Provides a test environment for ballistics studies and terminal effects.
- *Drop/Impact Complex*—Provides a controlled environment for high velocity impact testing on hard surfaces, water impact testing, and underwater testing.
- *Sled Track Complex*—Simulates high speed impacts of weapons shapes, substructures, and components to verify design integrity, performance, and fuzing functions; tests parachute systems to aerodynamic loads.
- *Centrifuge Complex*—Simulates the forces of acceleration produced by missiles and aircraft for test packages that include satellite systems, re-entry vehicles, rocket propellants, sensing devices of weapons, and weapons system components.

2.3.4.3 Accelerator Facilities

TA-IV contains several inertial-confinement fusion research and pulsed-power research facilities. Facilities include a large "Z-pinch" accelerator known as the Z-Machine, and the Simulation Technology Laboratory (STL), which houses seven pulsed-power accelerators that simulate the effects of nuclear detonations on nonnuclear components and subsystems. The accelerators are also used to conduct research on inertial-confinement fusion and particle-beam weapons. Another accelerator facility, SATURN, and a research facility are also located in TA-IV. Accelerator operations located in TA-IV are described below (SNL/NM 1997b).

- *SATURN Accelerator*—Simulates X-ray radiation effects of nuclear weapons on electronic and material components.
- *High-Energy Radiation Megavolt Electron Source III (HERMES III) Accelerator*—Provides gamma-ray effects testing for component and weapon systems development, which helps ensure operational reliability of weapon systems in radiation environments caused by nuclear explosions.

Accelerators

Accelerators are devices that accelerate (speed up) the movement of atomic-sized particles such as electrons, protons, and ions. These devices range in size from huge cyclotrons to television sets. The accelerators in TA-IV use pulsed-power technology and are called pulsed-power accelerators. Accelerators can produce radiation by accelerating atoms or their subatomic particles, which strike other target atoms, thereby producing prompt radiation such as X-rays or, in the case of accelerated protons, radioisotopes.

Pulsed-power accelerators are single-shot devices that accelerate large numbers of particles (energy) in a very short period. These accelerators are considered high power. The HERMES III accelerator, for example, can generate a 350-kJ pulse of electrons in 20 nsec, or 17 TW (17×10^{12} W) of power. However, because of the low shot rate of these machines (sometimes only one per day), the average power generated is typically very low. One of the areas of research being conducted in TA-IV is to increase the shot rate, or repetition rate, of these accelerators for applications that require high average power.

The TA-IV pulsed-power accelerators are designed to compress (in time) the electrical pulse. This generates high power by transferring a high percentage of the energy while shortening the pulse.

The desire to create controlled fusion for commercial power generation initially motivated the development of pulsed-power technology. Later, it was determined that the same technology could be used to generate X-rays and gamma rays for weapons testing. New uses for pulsed-power technology are continually being explored. Usually, a particular application will require some modification to existing devices, which adds knowledge to the pulsed-power technology base. Many applications, such as materials hardening and sterilization, have resulted in the development of high-power, high-repetition-rate accelerators.

- *Sandia Accelerator & Beam Research Experiment (SABRE)*—Supports the inertial confinement fusion program for advanced extraction ion diode research and for target and focusing studies.
- *Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX) Accelerator*—Measures X-ray-induced photocurrents from short pulses in integrated circuits and thermostructural response in materials.
- *Repetitive High Energy Pulsed-Power Unit I (RHEPP I) Accelerator*—Supports the development of technology for continuous operation of pulsed-power systems.
- *Repetitive High Energy Pulsed-Power Unit II (RHEPP II) Accelerator*—Supports the development of technology for continuous operation of pulsed-power systems for very high power outputs.
- *Z-Machine Accelerator (formerly the Particle Beam Fusion Accelerator)*—Generates high intensity light-ion beams for the inertial confinement fusion program and the high energy/density weapons physics program for stockpile stewardship.
- *Tera-Electron Volt Energy Superconductor Linear Accelerator (TESLA)*—Tests plasma opening switches for pulsed-power drivers.
- *Advanced Pulsed-Power Research Module (APPRM) Accelerator*—Tests the performance and reliability of components for use in a much larger accelerator still in the conceptual stage.
- *Radiographic Integrated Test Stand (RITS) Accelerator*—Simulates nuclear weapons effects on nonnuclear components and subsystems.

2.3.4.4 Reactor Facilities

TA-V is a highly secure, remote research area housing experimental and engineering nuclear reactors. Certain facilities in this area are being converted to production facilities for medical radioactive isotopes. Reactor operations located in TA-V are discussed below (SNL/NM 1997b).

- *New Gamma Irradiation Facility (NGIF)*—Produces a gamma radiation field, simulating weapons effects on nuclear weapons components.
- *Gamma Irradiation Facility (GIF)*—Provides high intensity gamma radiation for radiation environment testing of materials, components, and systems.
- *Sandia Pulsed Reactor (SPR)*—Simulates nuclear weapons effects on nuclear weapons components. The SPR houses two fast-burst reactors, SPR II and SPR III.
- *ACRR*—Formerly used for pulsed-power research; under conversion for the production of molybdenum-99 for use in nuclear medicine.

Reactors

Typically, reactors are devices that provide neutron and sustained gamma-pulsed environments. Normally, the SNL/NM reactors operate at steady-state power. These reactors are considered low power.

The reactors in TA-V conduct a variety of experiments, including those for DP system component electronics testing and reactor safety research.

The primary purpose for the ACRR is the production of medical isotopes.

TA-V reactors are designed as research reactors, small low-power reactors providing specialized near-fission ranges of radiation environments. SPR reactors, SPR II and SPR III, are small air-cooled reactors less than 8 ft tall. The ACRR would operate approximately 1,000 hours per year at a maximum power level of 4 MW (approximately 4,000 MWh per year). Commercial reactors operate at 1,000 MW of power (approximately 5,000,000 MWh per year).

The desire to produce medical isotopes can include expanding the range of isotopes to cover the broad field of medical isotopes and various research isotopes. The long-term, steady-state operation of the reactor for isotope production would allow experiments in areas of neutron irradiation, radiography, and other activities related to isotope production.

- *HCF*—Formerly used to support pulsed-power research; under conversion for processing irradiated targets from the ACRR and the production of molybdenum-99.

2.3.4.5 Outdoor Test Facilities

Selected outdoor test facilities are located in the Coyote Test Field and the Lurance Canyon Burn Site. The Coyote Test Field is a remote area containing physics testing facilities. Lurance Canyon was used for explosives testing. Although no explosives tests are currently being conducted at Lurance Canyon, burn tests are currently conducted there. Outdoor operations in the Coyote Test Field and several canyons are discussed below (SNL/NM 1997b).

- *Containment Technology Test Facility - West*—Provides nuclear power reactor containment model testing.
- *Explosives Applications Laboratory (EAL)*—Supports the design, assembly, and testing of explosive experiments in support of site-wide programs.
- *Aerial Cable Facility*—Provides a controlled environment for high velocity impact testing on hard surfaces and precision testing of full-scale, ground-to-air missile operations; air-to-ground ordnance testing; and nuclear material shipping container testing for certification.
- *Lurance Canyon Burn Site*—Provides safety testing of various hazardous material shipping containers, weapons components, and weapons mockups exposed to aviation fuel fires, propellant fires, and wood fires.
- *Thunder Range Complex*—Provides inspection facility capabilities and assembly and disassembly of special explosive-containing items. In the past, the facility was used for environmental, safety, and survivability testing for nuclear weapons applications.

2.3.4.6 Selected Infrastructure Facilities

All SNL/NM structures were evaluated to identify representative infrastructure facilities. Most SNL/NM infrastructure facilities are used for office space, storage, or support. Other infrastructure support related to roads and utilities is described in Section 4.4. Following are the major infrastructure facilities at SNL/NM that have environmental permits and that have been selected for evaluation:

- *Steam Plant in TA-I*—Provides heat and hot and chilled water to buildings in TA-I and the eastern portion of Kirtland Air Force Base (KAFB).
- *HWMF in TA-I*—Provides temporary storage for hazardous SNL/NM wastes prior to offsite treatment and/or disposal.
- *RMWMF in TA-III*—Processes LLW and LLMW generated at SNL/NM to meet waste acceptance criteria at designated DOE disposal sites.
- *Thermal Treatment Facility (TTF) in TA-III*—Thermally treats (burns) small quantities of waste explosive substances, waste liquids, and items contaminated with explosive substances.

2.3.5 Activities Common to All Alternatives

Some activities at SNL/NM are not expected to change significantly, regardless of which alternative the DOE selects for continued operations. In general, these balance of operations activities involve little or no toxic materials, are of low hazard, and are usually categories of actions excluded from analysis by DOE's NEPA regulations (see 10 Code of Federal Regulations [CFR] Part 1021). Balance of operations analyses were included for each resource area. These analyses are evaluated along with the more detailed analyses of the selected facilities for each alternative to provide the total impacts from SNL/NM operations. The balance of operations activities include many R&D activities and routine operations; infrastructure, administrative, and central services for SNL/NM; traffic flow adjustments to existing onsite roads in predisturbed areas, including road realignment and widening; facility maintenance and refurbishment activities; and environmental, ecological, and natural resource management activities. Some routine refurbishment, renovation, and small-scale removal of specific surplus facilities and closures will also continue at SNL/NM. Examples include office buildings, trailers, storage facilities, and infrastructure. A detailed description of these routine activities is available in the FSID (SNL/NM 1997b).

2.3.5.1 Research & Development Activities

R&D activities at SNL/NM are focused in the following areas: materials and process science, computational and information sciences, microelectronics and photonics sciences, engineering sciences, and pulsed-power sciences. Many aspects of the programs described in Section 2.1 fall into the area of R&D and are not analyzed in detail.

SNL/NM's research expertise in materials and process science develops the scientific basis for current and future mission needs. New and replacement materials are created for refurbished weapons components, enhanced safety subsystems, and advanced energy storage devices.

SNL/NM's research expertise in computational and information sciences develops technology to transition from model- and simulation-based life-cycle engineering. Increases in supercomputing capabilities are needed to analyze complicated accident scenarios, to design weapons components and systems, and to predict the aging of key stockpile materials.

SNL/NM's research expertise in microelectronics and photonics provides the science and technology to ensure implementation of its electronics systems. This research foundation conducts activities ranging from fundamental solid-state physics to design and fabrication of radiation-hardened integrated circuits.

SNL/NM's research expertise in engineering sciences focuses on model- and simulation-based, life-cycle engineering. Life-cycle engineering at SNL/NM occurs within a comprehensive validated modeling and simulation environment required for validation and verification of simulations.

SNL/NM's research expertise in fast pulsed-power technology applies pulsed-power technological advances in conjunction with other DOE laboratories, U.S. industry, and universities. SNL/NM supports science-based stockpile stewardship by providing radiation experiments to certify the survivability of strategic systems in the stockpile and to support DOE initiatives such as the Stockpile Life Extension Program. The large-volume, high-temperature, high-energy-density environments uniquely generated with pulsed power have produced a unique opportunity to collaborate with Lawrence Livermore National Laboratory and Los Alamos National Laboratory (LANL) in weapons physics and experimentation. These capabilities are especially critical in the absence of underground nuclear testing for certification of weapons survivability and performance (SNL/NM 1997b).

2.3.5.2 Maintenance Support Activities

These activities comprise frequently and routinely requested maintenance services for operational support of SNL/NM facilities and associated DOE properties. Activities range from ongoing custodial services to corrective, preventive, predictive, and training actions required to maintain and preserve buildings, structures, roadways (including widening in disturbed areas), and equipment in a condition suitable for fulfilling their designated purposes. While these activities are intended to maintain current operations, they would not substantially extend the life of a facility or allow for substantial upgrades or improvements.

2.3.5.3 Material Management and Operations

Routine operations at SNL/NM require the management of hazardous, industrial, commercial, and recyclable materials. Appendix A contains information regarding the responsible organizations, regulatory requirements, and

Hazardous Material

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

types and quantities of material at SNL/NM. SNL/NM standards, which were developed in accordance with DOE, DOT, and U.S. Air Force policies, determine if a material constitutes an onsite hazard.

Four types of hazardous material regulated by the DOT are tracked by SNL/NM. These include radioactive materials, chemicals, explosive materials, and fuels.

2.3.5.4 Chemical Materials Management and Control

The primary goal for managing and controlling chemicals at SNL/NM is to protect the health and safety of workers, the public, and the environment.

Chemical Materials

SNL/NM handles more than 25,000 chemical containers annually. Chemicals are designated as hazardous if they present either a physical or a health hazard as defined by the DOT and listed in 49 CFR §172.101. Chemicals are managed using administrative and physical controls that are designed to minimize exposure to an identified hazard. Facilities that use and store chemicals are evaluated using SNL/NM's Integrated Safety, Environmental, and Emergency Management System for determining appropriate approaches to managing and controlling hazards.

Historic Chemical Materials Use

SNL/NM previously maintained inventories of hazardous chemicals at levels sufficient to meet immediate needs that could arise at any time. This approach involved economical bulk chemical purchases; however, this approach also led to the shelf life of some containers expiring before they could be used. These chemical procurement practices created legacy chemicals that had to be disposed of properly. Now, SNL/NM orders needed chemicals on a "just-in-time" basis.

Baseline Hazardous Chemical Materials Use

From 1990 through 1996, SNL/NM primarily tracked chemical inventories using the CheMaster System. This system was designed primarily to enable SNL/NM to meet the requirements of the *Emergency Planning Community Right-to-Know Act* (EPCRA), also known as *Superfund Amendments and Reauthorization Act, Title III* (SARA) (42 United States Code [U.S.C.] §11001). EPCRA requires that a facility generate an annual list documenting the presence of certain hazardous chemicals in quantities exceeding federally prescribed safety thresholds and provide the list to emergency planning officials in the state and local community.

SNL/NM is currently changing to a new chemical inventory tracking system known as the *Chemical Information System* (CIS). This system, a commercial program developed by AT&T, provides features not available with the former system that allow the tracking of individual containers and access to online chemical inventory data at any time. This system also interfaces more readily with other environment, safety, and health programs, including those for industrial hygiene, hazardous waste management, radioactive and mixed waste management, waste minimization, emergency preparedness, fire protection, and NEPA. For NEPA, the CIS provides essential information on the chemical inventory and is a necessary element for calculating potential health effects.

2.3.5.5 Explosive Material Management and Control

SNL/NM manages explosive material through the *Explosive Inventory System*, a comprehensive database that tracks explosives and explosive-containing devices and assemblies from acquisition through use, storage, reapplication, and transfer or disposal. It provides information on material composition, characteristics, shipping requirements, life-cycle cost, plan of use, and duration of ownership. This system includes an inventory of explosive material owned or controlled by SNL/NM line organizations.

2.3.5.6 Radioactive Material Management and Control

SNL/NM uses a twofold approach to radioactive material management: reduce surplus legacy radioactive material inventories and manage current nuclear material inventories at mission-essential levels. Nuclear material is a subclass of radioactive material as defined

by the *Atomic Energy Act of 1954* (AEA) (42 U.S.C. §2011). SNL/NM manages the three types of accountable nuclear material—special nuclear material, source material, and other nuclear material—through an inventory database known as the *Local Area Network Nuclear Material Accountability System (LANMAS)*.

2.3.5.7 Waste Management and Operations

Waste Operations

This section generally describes waste operations that are not analyzed in detail, as noted in Section 2.3.5.

SNL/NM manages all wastes in accordance with applicable Federal, state, and local laws and regulations and DOE Orders. These wastes are primarily regulated by the EPA, the DOE, and the New Mexico Environment Department (NMED). All current waste operations are being implemented following SNL/NM policies established to ensure worker and public safety and compliant management of regulated waste. These policies clearly define waste acceptance and disposal criteria, limit the number of workers who handle wastes, provide appropriate waste-specific training, and centralize waste handling areas.

Hazardous Waste

Hazardous wastes managed at the HWMF include wastes regulated under *Resource Conservation and Recovery Act* (RCRA) (42 U.S.C. §6901) and wastes regulated under the *Toxic Substances Control Act* (TSCA) (15 U.S.C. §2601); other wastes managed at the HWMF including wastes not regulated by RCRA or TSCA, but still hazardous; certain other solid wastes; and some other wastes not accepted by the Solid Waste Transfer Facility (SWTF). The hazardous waste generated at SNL/NM is predominantly from experiments, testing, other R&D activities, and infrastructure fabrication and maintenance. Environmental restoration and decontamination and decommissioning (D&D) also generate hazardous waste. Hazardous waste generated at each facility is usually coordinated by that facility's waste management department, with the exception of waste from large projects focused on asbestos abatement, which is managed separately through subcontracts.

SNL/NM also manages small amounts of waste from other SNL or DOE operations, such as SNL's Advanced Materials Laboratory on the University of New Mexico campus in Albuquerque or the DOE's Albuquerque Operations Office.

Radioactive Waste

The RMWMF staff manages LLW, LLMW, TRU waste, and MTRU waste for SNL/NM. In general, LLW and LLMW are generated during laboratory experiments and component tests. TRU and MTRU wastes are generated from the use of small quantities of plutonium and other TRU isotopes in R&D or from experiments involving nuclear reactor operations, including cleanup of residuals during reactor tests. Additional small quantities of LLW can be received periodically from remote test facilities including Kauai, Hawaii; White Sands Missile Range, New Mexico; and Tonopah Test Range, Nevada. LLMW generated at Sandia National Laboratories/California has also been shipped to SNL/NM for management in accordance with an NMED compliance order issued under the *Federal Facility Compliance Act* (42 U.S.C. §6961). SNL/NM has also received TRU waste from the Lovelace Respiratory Research Institute, which is DOE-funded and located on KAFB (Section 6.2.6).

2.3.5.8 Environmental Restoration

The ER Project is a phased project designed to identify, assess, and remediate contaminated DOE-owned or -operated sites that have contamination from waste disposal, releases, or spills of hazardous substances. The initial remedial assessment of SNL/NM sites was conducted under the Comprehensive Environmental Assessment and Response Program beginning in 1984 and ending in 1987. The assessment identified 117 potential release sites. By 1993, the number had increased to 219 potential release sites (including offsite locations).

Other Waste Categories

Hazardous Waste—Any solid waste (definition includes semisolid, liquid, or gaseous material) having one or more characteristics of ignitability, corrosivity, toxicity, or reactivity or any other waste specifically regulated as a hazardous waste, by the *Resource Conservation and Recovery Act* (RCRA).

Nonhazardous Waste—Chemical waste not defined as a RCRA hazardous waste. The term nonhazardous waste does not necessarily imply the level of protection needed to properly manage the waste.

Radioactive Waste Categories

Low-Level Waste (LLW)—Waste that contains radioactivity and is not classified as high-level waste, TRU waste, spent nuclear fuel, or byproduct tailings containing uranium or thorium from processed ore (as defined in Section 11[e][2] of the AEA [42 U.S.C. §2011]). Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as LLW, provided that the concentration of TRU is less than 100 nCi/g.

Low-Level Mixed Waste (LLMW)—Waste that contains both hazardous waste under the RCRA (42 U.S.C. §6901) and source, special nuclear, or byproduct material subject to the AEA (42 U.S.C. §2011).

Transuranic Waste (TRU)—Waste that contains more than 100 nCi of alpha-emitting TRU isotopes per gram of waste, with a half-life greater than 20 years, except for (a) high-level radioactive waste; (b) waste that the Secretary has determined, with concurrence of the Administrator, does not need the degree of isolation required by the disposal regulations; or (c) waste that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

Mixed Transuranic Waste (MTRU)—TRU waste that contains hazardous waste, as defined and regulated under the RCRA (42 U.S.C. §6901).

Hazardous and Solid Waste Amendments (HSWA)

The HSWA were proposed in 1984 by the EPA as amendments to the RCRA (42 U.S.C. §6901). A very important aspect of HSWA requires that release of hazardous wastes or hazardous constituents from any solid waste management unit that is located on the site of a RCRA-permitted facility be cleaned up. The cleanup is required regardless of when the waste was placed in the unit or whether the unit was originally intended as a waste disposal unit. SNL/NM's HSWA module to the RCRA Part B permit includes provisions for corrective actions for all releases. It also contains a compliance schedule that governs the corrective action process.

A Hazardous and Solid Waste Amendments (HSWA) module of the RCRA permit was issued in August 1993. As co-permittees, both SNL/NM and the DOE are responsible for compliance under the terms of the HSWA permit. The EPA Region 6 (Dallas, Texas) was the authorized permitting agency at the time of issuance, but beginning in January 1996, authority was transferred to the NMED. The terms, conditions, and schedule contained in the original HSWA Part B permit are, and continue to be, the primary legal drivers for the ER Project.

The remediation field activities under the ER Project are scheduled for completion in Fiscal Year (FY) 2002, with permit modification by FY 2004 to remove remediated sites from further action. Subsequent monitoring activities are scheduled for an additional 30 years. As of August 1998, 60 sites remained on the list for restoration or additional assessment. SNL/NM has proposed no further action for 122 of the 182 sites to the appropriate regulatory authority.

The ER Project is currently the largest generator of regulated waste at SNL/NM. The project can potentially generate wastes of varying types due to the many kinds of material that have historically been handled at SNL/NM. For example, these wastes may consist of contaminated soils, debris, wastewater, and used personal protective equipment. The waste categories include LLW, LLMW, RCRA hazardous waste, TSCA waste, biohazardous waste (such as septic tank sludge), and nonhazardous waste.

ER Project generated waste is processed through the HWMF, the RMWMF, or the SWTF. Once accumulated, sampled, and fully characterized, ER Project-generated waste is transferred to the appropriate SNL/NM waste management department for treatment, storage, and offsite disposal. The time frame for disposal of waste, once removed from a release site, can be months or years, depending on the time required for characterization and for scheduling shipment to disposal facilities.

In June 1996, SNL/NM submitted a request for a permit modification for a Corrective Action Management Unit (CAMU) designed to be a storage, treatment, and containment unit dedicated to ER Project-generated hazardous waste (SNL/NM 1997a). This unit will be located near the former Chemical Waste Landfill (a site scheduled for remediation and closure under a RCRA

Low-hazard Nonnuclear

"Low-hazard nonnuclear" are facilities or project activities that have the potential for minor onsite impacts (within the boundaries of SNL/NM-controlled areas) and negligible offsite impacts (outside the boundaries of SNL/NM-controlled areas) to people or the environment. SNL/NM uses primary hazards screening (PHS) to identify hazards, hazard classifications, training requirements, and required safety documents. A "low-hazard nonnuclear" facility does not require additional safety documentation. Accelerators and reactors do not meet this definition and require additional safety documentation including safety assessments and safety analysis reports.

Closure Plan). SNL/NM security personnel will provide controlled access. The SNL/NM waste management departments will continue to manage waste generated by the ER Project, excluding hazardous waste designated for containment in the CAMU. The CAMU was approved in September 1997 by EPA Region 6. An environmental assessment was prepared for the ER Project at SNL/NM. It analyzes potential environmental effects of the characterization and waste cleanup or corrective action of environmental restoration sites (DOE 1996c). The impacts of the ER Project are incorporated into the analysis of the SWEIS.

2.3.5.9 Pollution Prevention and Waste Minimization

SNL/NM has implemented a Pollution Prevention Program to comply with DOE requirements. SNL/NM's Pollution Prevention Program applies to all pollutants generated by routine and nonroutine operations. It consists of activities that encourage pollution prevention or waste source reduction, recycling, resource and energy conservation, and procurement of EPA-designated recycled products.

2.3.5.10 Recycling

SNL/NM currently has recycling processes for plain paper, cardboard, used oil, scrap metal, batteries, fluorescent light bulbs, solvents, mercury, landscaping waste, aluminum cans, tires, and used toner cartridges. At present, all paper and corrugated paper recycled at SNL/NM are processed through the SWTF. In 1996, SNL/NM initiated a joint effort with LANL to collect, process, and market LANL-generated recyclable paper. After creating the process, the program was expanded to include the DOE/Kirtland Area Office. Over the next few years, efforts will continue to expand cooperation with other Federal and state facilities.

2.3.6 Selected Facilities

Following Chapter 2 are a series of facility descriptions that provide additional detail for all of the facilities that are named in Sections 2.3.4.1 through 2.3.4.6. They consist of a brief description of the location, hazard class (low-hazard nonnuclear), primary purpose, and the major types of activities performed at the facility. Also identified are the basic processes performed at the facility, the programs and activities currently being supported, the major categories of radioactive and hazardous materials used by the processes, and the types or radioactive and hazardous emissions or wastes generated by activities at the facility. For all of the facilities described here and for each of the three alternatives described in Chapter 3, the FSID (SNL/NM 1997b) contains more detail including the estimated quantities for the specific radioactive and hazardous chemicals used and emissions or waste generated by a facility's operations. All of these details were considered in completing the consequence analysis in Chapter 5.