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Facilities and Safety Information Document

Volume I

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ABSTRACT

The Sandia National Laboratories/New Mexico Facilities and Safety Information Document describes specific attributes of SNL/NM facilities and the environmental, safety, and health aspects of the operations within those facilities. The Sandia National Laboratories/New Mexico Facilities and Safety Information Document presents the following:

- An overview of SNL facilities and infrastructure
- An overview of the programs that help to ensure the safety and health of workers, to protect the environment, and to protect SNL/NM assets
- Information about the purpose, operations, hazards, hazard controls, and occurrences at relevant facilities and risk management methods for SNL/NM facilities that merit DOE-specified safety measures in their design and operation
- Information on current activities that SNL/NM programs pursue at relevant facilities
- Projections for a set of "selected" and infrastructure facilities with regard to alternatives for activities, inventories, material consumption, emissions, wastes, and resource consumption

PREFACE

SNL/NM is comprised of many diverse capabilities that support national security missions as well as other programs. The same capabilities sustain a variety of research needs for a variety of clients. To compile a framework for assessing the diversity of these activities, SNL/NM first considered 670 buildings within SNL/NM's five technical areas (TAs). To make the task of collecting data and information manageable, SNL/NM identified 64 so-called notable facilities that characterized the Laboratories' project work as a whole.

From the list of notable facilities, 33 facilities were chosen that were representative of continuing or potential activities and the environmental effects associated with those activities. These "selected facilities" were assessed in more detail, which included collecting information about projected activities at these facilities, such as projections of hazardous material consumption, hazardous waste generation, and other potential environmental issues.

Information on these "selected facilities" was obtained in a cooperative research effort working directly with program and facility representatives for each of the facilities. From this cooperative effort, projections were made of future activities at these facilities through the year 2008. An effort was made to ensure that these projections are as conservative and reasonable as possible, in light of the uncertainties affecting national defense needs for the future, and the responsibility that SNL/NM and DOE have in maintaining the existing weapons stockpile.

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Those individuals who provided specific information on selected facilities for the *Sandia National Laboratories/New Mexico Facilities and Safety Information Document* are listed in the Contributors section at the end of Volume II. Many other individuals within and outside SNL/NM are acknowledged for their oversight and for their review of information for accuracy and completeness.

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INTRODUCTION

Analysis of environmental impacts at SNL/NM requires a comprehensive understanding of the following:

- SNL/NM missions and related programs.
- SNL facilities, including the history, safety features, and current and planned operations and capabilities of these facilities.

To provide DOE and its contractor with detailed information about SNL/NM programs, facilities, and environmental baseline information, SNL/NM has prepared two important documents:

- *Sandia National Laboratories/New Mexico Environmental Information Document*, providing baseline information describing the environmental setting at SNL/NM and surrounding areas. This includes information drawn from interdisciplinary sources such as environmental monitoring, various project studies pursuant to NEPA, and other information sources.
- *Sandia National Laboratories/New Mexico Facilities and Safety Information Document*, providing information on specific attributes of relevant facilities and the health and safety aspects of the operations within those facilities. The *Sandia National Laboratories/New Mexico Facilities and Safety Information Document* includes the following:
 - An overview of the facilities and infrastructure essential to carrying out SNL/NM programs.
 - An overview of the programs that help to ensure the safety and health of workers, to protect the environment, and to protect SNL/NM assets.
 - Information about the purpose, operations, hazards, hazard controls, and occurrences at relevant facilities and risk management methods for SNL/NM facilities that merit DOE-specified safety measures in their design and operation.
 - Information on current activities that SNL/NM programs pursue at relevant facilities.

- Projections for a set of “selected” and infrastructure facilities with regard to alternatives for activities, inventories, material consumption, emissions, wastes, and resource consumption.
- A facilities appendix that includes those SNL/NM facilities not designated as notable, which are not discussed in detail in the *Sandia National Laboratories/New Mexico Facilities and Safety Information Document*.

The information documents will:

- Help guide the structure of the SWEIS and facilitate the analysis of actions required by the Council on Environmental Quality and DOE's guidelines for implementing NEPA.
- Focus on the NEPA process by screening out unessential details from various SNL/NM program sources.
- Provide relevant information not otherwise available (for example, measurable information on the characteristics of programs and activities, which is useful in determining the change that results from new or expanded operations).
- Provide a baseline reference tool that can be updated to address changes in laboratory operations, which will streamline the preparation of future SNL/NM NEPA documents.

Where appropriate, the information documents will cross-reference one another to provide readers with more information on subjects that cut across facilities, programs, safety concerns, and potential environmental impacts. The information documents do not analyze impacts or present conclusions regarding SNL/NM's current or planned missions; those will be the objectives of the SWEIS. However, the information documents will facilitate the detailed technical studies performed by those who prepare the SWEIS.

READER'S GUIDE

The *Sandia National Laboratories/New Mexico Facilities and Safety Information Document* provides information about facilities, infrastructure, and programs at SNL/NM.

Chapter 1, "General Site and Facility Information," contains information on the following:

- Site history and setting
- "Notable," "selected" and "infrastructure" facilities and the criteria for identifying them
- Sources of information on SNL facilities from which the *Sandia National Laboratories/New Mexico Facilities and Safety Information Document* draws its content
- General information about SNL/NM facilities, including locations and demographics

Chapter 2, "Planning and Management of Assets at SNL/NM Facilities," describes the programs that help to plan, manage, and protect SNL/NM physical assets.

Chapter 3, "Safety, Health, and Environmental Protection at SNL/NM Facilities," describes the programs that help to protect the health and safety of workers and to protect the environment.

Chapter 4, "Notable Facility Reports," provides more detailed information for a subset of 13 facilities that the SNL sitewide environmental impact statement (SWEIS) support project staff identified as "notable." The kinds of information for each notable facility in Chapter 4 include the following:

- Purpose and need for each facility
- Description of each facility, including descriptions of structures and major equipment
- SNL/NM programs that use each facility
- Summary of operations at each facility

- Discussions of the hazards at each facility and the controls that are in place to mitigate or eliminate those hazards
- For each nuclear facility, moderate- and high-hazard nonnuclear facility, and accelerator facility, a discussion of the results of safety analyses drawn from existing safety documentation (safety analysis reports for nuclear and high-hazard nonnuclear facilities, safety assessments for moderate-hazard nonnuclear facilities, and safety assessment documents for accelerator facilities)
- Information on occurrences

Chapter 5 through Chapter 15 provide information on “selected” and “infrastructure” facilities. In designing their methodology for sitewide environmental impact analysis, DOE and its contractor decided to perform a detailed analysis of groups of selected SNL facilities that represent at least 90 percent of the SNL/NM operations that have the potential to cause significant environmental impacts. DOE also selected several infrastructure facilities for detailed information and analysis.

To support the sitewide environmental impact statement analysis, SNL projected and reported alternatives for activities, inventories, material consumption, emissions, wastes, and resource consumption for each infrastructure facility and for each facility within each selected facility group as follows:

- The “reduced alternative” represents the minimum levels of activities, inventories, material consumption, emissions, wastes, and resource consumption necessary to maintain the facility and equipment in an operational readiness mode and to ensure that there are sufficient staff with the knowledge, training, and hands-on experience to perform the operations.
- The “no action alternative” assumes that there are no program mission changes and represents continuation of activities, inventories, material consumption, emissions, wastes, and resource consumption in support of SNL/NM’s current missions. The no action alternative is broken out into three categories:
 - “No action base year,” which represents current levels of activities, inventories, material consumption, emissions, wastes, and resource consumption.
 - “No action 2003,” which represents a projection over the next five years of activities, inventories, material consumption, emissions, wastes, and resource consumption.

- “No action 2008,” which represents a projection over the next ten years of activities, inventories, material consumption, emissions, wastes, and resource consumption.
- The “expanded alternative” represents the highest levels of activities, inventories, material consumption, emissions, wastes, and resource consumption that the facility can support. This alternative may include multiple shift operations, some reconfiguration of equipment, and construction to modify existing buildings.

Chapter 5, “Summaries of Alternatives for Selected and Infrastructure Facilities,” summarizes the alternatives for activities, inventories, material consumption, emissions, wastes, and resource consumption for each infrastructure facility and for each facility within each selected facility group. The remaining chapters provide the same types of information for selected and infrastructure facilities as Chapter 4 provides for notable facilities, and these chapters also include detailed information on alternatives and assumptions for activities, inventories, material consumption, emissions, wastes, and resource consumption:

- Chapter 6, “Neutron Generator Facility Source Information”
- Chapter 7, “Microelectronics Development Laboratory Source Information”
- Chapter 8, “Explosive Components Facility Source Information”
- Chapter 9, “Advanced Manufacturing Processes Laboratory Source Information”
- Chapter 10, “Integrated Materials Research Laboratory Source Information”
- Chapter 11, “Physical Testing and Simulation Facilities Source Information,” which includes discussion of testing facilities in Tech Area III
- Chapter 12, “Accelerator Facilities Source Information,” which includes discussion of the accelerator facilities in Tech Area IV
- Chapter 13, “Reactor Facilities Source Information,” which includes discussion of the nuclear facilities in Tech Area V
- Chapter 14, “Outdoor Test Facilities Source Information,” which includes discussion of the testing facilities in Coyote Test Field

- Chapter 15, "Infrastructure Facilities Source Information," which includes discussion of facilities that manage of all of SNL/NM's hazardous, radioactive, and mixed wastes

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1.0 IDENTIFICATION OF NOTABLE, SELECTED, AND INFRASTRUCTURE FACILITIES

Notable facilities at SNL/NM are those that meet the following criteria:

- Criterion 1:
 - Nuclear or high-hazard nonnuclear facilities, which require safety analysis reports
 - Moderate-hazard nonnuclear facilities, which require safety assessments
 - Accelerator facilities, which require safety assessment documents
- Criterion 2: Facilities that require offsite emergency planning
- Criterion 3: Facilities that require environmental permits
- Criterion 4: Facilities with outdoor testing
- Criterion 5: Facilities located on non-DOE property

The SNL Sitewide Environmental Impact Statement Support Project staff identified and provided descriptions of 64 SNL/NM facilities that meet the criteria for notable facilities for DOE and the contractor responsible for preparing the sitewide environmental impact statement. DOE and its contractor reviewed the notable facility descriptions and decided to perform a more detailed analysis of a subset of the notable facilities known as “selected” facilities. DOE and its contractor determined that these facilities represent at least 90 percent of the SNL/NM operations that have the potential to cause significant environmental impacts.

DOE selected the following facilities and facility groups for detailed information and analysis:

- Neutron Generator Facility
- Microelectronics Development Laboratory
- Outdoor Test Facilities

- Integrated Materials Research Laboratory
- Explosive Components Facility
- Physical Testing and Simulation Facilities
- Accelerator Facilities
- Reactor Facilities
- Advanced Manufacturing Process Laboratory

DOE also selected the following infrastructure facilities for detailed information and analysis:

- Steam Plant
- Hazardous Waste Management Facility
- Radioactive and Mixed Waste Management Facility
- Thermal Treatment Facility

These infrastructure facilities manage all of SNL/NM's hazardous, radioactive, and mixed wastes. The Steam Plant produces approximately 97 percent of all criteria air emissions at SNL/NM through natural gas consumption; the Explosives Components Facility produces most of the remainder.

2.0 PLANNING AND MANAGEMENT OF ASSETS AT SNL/NM FACILITIES

SNL/NM has several programs to manage its approximately 1,000 facilities of all types, which range from special research and development facilities to numerous storage structures and mobile office spaces.

2.1 Safeguards & Security

Much of the work at SNL/NM takes place at facilities with controlled access to protect national security secrets and to safeguard nuclear and other sensitive materials and technology.

Programs for protection of assets include the following:

- Nuclear Material Control and Accountability
- Physical Protection of Assets
- Computer Security
- Security Education and Awareness Program
- Operations Security Program
- Classified Work for Others and Special Access Program
- Counterintelligence Program
- Protective Force Services

2.2 Facilities Business Unit

The Facilities Business Unit provides the essential services to plan and manage the SNL/NM site, its infrastructure, and facilities:

- Electrical Engineering Services
- Facilities Maintenance Program
- Mechanical Infrastructure
- Centralized Services
- Facilities ES&H
- Sites Planning
- Corporate Projects
- Electrical, Structural & Landscaping Services
- Custodial Matrixed Services
- Fleet Management Services
- Facilities Express
- Fire Protection

2.3 Procurement and Logistics Center

Procurement and Logistics Center services apply to the movement of various items to and from SNL/NM as well as distribution among SNL/NM facilities:

- Shipping, Receiving and Mail Services
 - Reapplication/Recycling
 - Storage, Transportation and Distribution Services
-

3.0 SAFETY, HEALTH, AND ENVIRONMENTAL PROTECTION AT SNL/NM FACILITIES

The environment, safety, and health (ES&H) services in place at SNL/NM are essential to the support of SNL's mission-driven activities. The inherent occupational and environmental hazards present in performing these activities require precautions and controls commensurate with hazards. SNL is committed to performing its strategic mission without adverse effects on the environment or the health of its employees and the public.

ES&H programs at SNL/NM facilitate compliance with federal, state, and local regulations, DOE directives (policy, rules, orders, notices, standards, and guidance), and SNL's internal management policies. The ES&H Center (7500) provides interdisciplinary ES&H support teams to assist SNL divisions in conducting their operations in a safe, healthful, and environmentally compliant manner. Each team contains subject matter experts with expertise in specific ES&H program areas, which makes each team a unit that can address ES&H issues and concerns related to the following:

- Industrial hygiene
- Radiation protection
- Environmental protection
- Waste management
- Safety engineering

4.0 NOTABLE FACILITIES AT SNL/NM

4.1 Notable Facilities in Tech Area I

SNL's Tech Area I contains laboratories, shops, and office buildings used by administrative and technical staff for various activities, including the following:

- Administration
- Technical support
- Basic research
- Microelectronics
- Exploratory systems
- Business outreach
- Site support
- Component development
- Energy programs
- Defense programs
- Technology transfer

Tech Area I includes nine notable facilities. The missions for these facilities include the following:

- Advanced ion beam capabilities for materials research and development
- Research to increase the cost-effectiveness of solar cells
- Generation of simulated lightning to test nuclear weapon designs and safety-critical components for conformance to nuclear safety requirements
- Laboratory work for a variety of energy-related research programs
- Investigation of the physics of compound semiconductors and device structures
- Research and development for the design, development, and prototyping of thermal and lithium batteries and parachutes

- Basic and applied research and establishment of theories and models in the areas of materials science, solid-state physics, and accelerator physics
- Support to the DOE Conservation and Renewable Energy National Photovoltaics Program

4.2 Notable Facilities in Tech Area III

Tech Area III includes three notable facilities. These facilities and their missions include the following:

- The Radiant Heat Facility provides the capability to study or prove the ability of a test item, such as a satellite component or a transportation container, to withstand an accident involving a fire. These tests are required by organizations such as the Nuclear Regulatory Commission and the U.S. Department of Transportation.
- The mission of the Liquid Metal Processing Laboratory is to provide:
 - Research in metals and solidification practices and processes.
 - Assistance to the specialty metals industry to help make this industry more competitive in the world market.
 - Support of SNL's and DOE's weapons research community in the form of prototypic investment castings.
 - Assistance to industry in the development of castings and the understanding of processes.
 - Development to demonstrate the feasibility of recycling radioactively contaminated metals.
 - Production of special metal alloys as needed by the weapons research community.
- The purpose of the Classified Destruction Facility is to reduce classified information (paper, computer tapes, and microfiche) to a controllable grade of residue. Among the equipment used to perform this activity are the Hammermill macerator, which reduces paper documents, and the Micro DoD plastics shredder, which reduces plastics and film.

4.3 Notable Facilities in Tech Area IV

Tech Area IV includes four notable facilities, nearly all of which are accelerator facilities. Specific missions of Tech Area IV notable facilities include the following:

- Development of sources of high-power microwaves to provide a large, high-quality, electromagnetic test facility capable of supporting DOE and U.S. Air Force vulnerability and susceptibility testing requirements.
- Investigation and development of materials processing technologies using high peak-power laser energy.

4.4 Notable Facilities in Coyote Test Field and Manzano Area, and Other Leased Areas

Coyote Test Field and Manzano Area contain 18 notable facilities. The missions of these facilities include the following:

- Storage of mixed waste, low-level radioactive waste, and transuranic waste
- Test operations that provide high thermal flux for the following:
 - Solar applications
 - Investigation of the thermophysical properties of materials
 - Measurements of the thermal performance of components and materials
 - Measurements of the effects of aerodynamic heating on radar transmission
 - Simulation of nuclear thermal flash
- Testing of various intrusion detection sensors that are used by DOE, DoD, and the private sector

5.0 SNL/NM SELECTED AND INFRASTRUCTURE FACILITIES

To support the sitewide environmental impact statement analysis, SNL projected alternatives for activities, inventories, material consumption, emissions, wastes, and resource consumption for each infrastructure facility and for each facility within each selected facility group as follows:

- The “reduced alternative” represents the minimum levels of activities, inventories, material consumption, emissions, wastes, and resource consumption necessary to maintain the facility and equipment in an operational readiness mode and to ensure that there are sufficient staff with the knowledge, training, and hands-on experience to perform the operations.
- The “no action alternative” assumes that there are no program mission changes and represents continuation of activities, inventories, material consumption, emissions, wastes, and resource consumption in support of SNL/NM’s current missions. The no action alternative is broken out into three categories:
 - “No action base year,” which represents current levels of activities, inventories, material consumption, emissions, wastes, and resource consumption.
 - “No action 2003,” which represents a projection over the next five years of activities, inventories, material consumption, emissions, wastes, and resource consumption.
 - “No action 2008,” which represents a projection over the next ten years of activities, inventories, material consumption, emissions, wastes, and resource consumption.
- The “expanded alternative” represents the highest levels of activities, inventories, material consumption, emissions, wastes, and resource consumption that the facility can support. This alternative may include multiple shift operations, some reconfiguration of equipment, and construction to modify existing buildings.

The alternatives for activities, inventories, material consumption, emissions, wastes, and resource consumption for each infrastructure facility and for each facility within each selected facility group are provided in Chapter 6 through Chapter 15. The remainder of this section summarizes descriptions of operations and the activity scenarios for each of the selected and infrastructure facilities and the facilities within the selected facility groups.

5.1 Neutron Generator Facility

5.1.1 Operations

Operations at the Neutron Generator Facility include fabrication of war reserve neutron generators and prototype switch tubes. Neutron generators initiate nuclear fission in a nuclear weapon by providing a flux of neutrons at the proper time.

5.1.2 Alternatives

5.1.2.1 No Action

The base year activity is the manufacture of an estimated 600 neutron generators for 1998, which is the first year in which the facility will achieve its initially planned level of production. Under the no action alternative, the Neutron Generator Facility would utilize existing SNL/NM infrastructure for war reserve production and development. Production of neutron generators is expected to increase to 2,000 unit per year within the 2003 and 2008 timeframes.

5.1.2.2 Expanded

The level of production of 2,000 neutron generators within the 2003 and 2008 timeframes is the maximum production attainable within the existing facility. Under the expanded alternative, the Neutron Generator Facility would utilize existing SNL/NM infrastructure and renovated buildings for war reserve production and development.

The operating levels specified under the expanded alternative are sufficient to replace units at end of life and maintain current stockpile levels. These operating levels can be supported within the existing facility by rearranging and relocating certain operations.

5.1.2.3 Reduced

The operating level under the reduced alternative is also estimated at 2,000 neutron generators per year. Although the facility could manufacture significantly less than the projected number, mission requirements would not allow production levels to drop below the 2,000 limit.

5.2 Microelectronics Development Laboratory

5.2.1 Operations

The broad range of microtechnology development and engineering capabilities at the Microelectronics Development Laboratory are divided into four broad subprocesses:

- Film deposition
- Etching
- Photolithography
- Ion implantation

Integrated circuits, micromechanical structures, and sensors are formed entirely on silicon dies or chips through various steps that could involve some or all of the above subprocesses.

5.2.2 Alternatives

5.2.2.1 No Action

The present production of wafers at the Microelectronics Development Laboratory is 4,000 wafers per year, based on one and one-quarter shifts of operation. The increase to 5,000 wafers in the year 2003 is based on expected increased efficiencies in processes and one and one-half shifts of operation. Production in the year 2008 is estimated at 7,000 wafers because of predicted Moore's law, approximately two shifts of operation, and a breakthrough in processing technologies.

5.2.2.2 Expanded

The expanded alternative of production of 7,500 wafers is a function of technology and new methodologies, coupled with increasing the work period to three shifts. Included with expanded activities of the MDL is the development of the Microsystems and Engineering Science Applications (MESA) Complex. Major components of the MESA Complex would be constructed adjoining the MDL, with support structures (light laboratories and offices) located nearby. By sharing modernized equipment with the MDL, the MESA Complex would integrate activities of both the MDL and the Compound Semiconductor Research Laboratory (CSRL).

5.2.2.3 Reduced

Under the reduced alternative, 2,666 wafers would be produced, based on a single-shift operation.

5.3 Explosive Components Facility

5.3.1 Operations

The Explosive Components Facility consolidates a number of ongoing activities related to explosive components, neutron generators, and battery research, testing, development, and quality control into a single structure. In operation, the Explosive Components Facility facilitates the coordination of these activities to enhance both safety and productivity.

5.3.2 Alternatives

5.3.2.1 No Action

The Explosive Components Facility supports the work performed at the Neutron Generator Facility; the base year of 200 neutron generator tests is for FY1997. The operating levels at the Explosive Components Facility are sufficient to test units produced and to do development testing. When full production at the Neutron Generator Facility begins, the number of neutron generator tests at the Explosive Components Facility ramps up sharply to 500 tests throughout the 2003 and 2008 timeframes.

The no action values for explosive testing are 600 tests for the base year (FY1997), 750 tests for 2003, and 850 tests for 2008. Explosive tests include detonations and deflagrations, regardless of the amount and type (for example, UNO 1.1) of energetic material expended. The operating level for no action values assumes only minimal increases in activity from inflation and only minimum additional success in Work For Others and Laboratory-Directed Research and Development initiatives.

The no action values for chemical analyses are 900 analyses for the base year (FY1997), 950 analyses for 2003, and 1,000 analyses for 2008. Chemical analysis includes techniques such as spectroscopy, chromatography, calorimetry, and morphology. The operating level for no action values assumes only minimal increases in activity from inflation and only minimum additional success in Work For Others and Laboratory-Directed Research and Development initiatives.

The no action values for battery testing are 50 tests for the base year (FY1997) and 60 tests for 2003 and 2008. The operating level for no action values assumes only minimal increases in activity from inflation and only minimum additional success in Work For Others and Laboratory-Directed Research and Development initiatives.

5.3.2.2 Expanded

The operating levels in the expanded alternative for the Explosive Components Facility should be sufficient to maintain the 500 neutron generator tests as the maximum level of production. However, staffing levels would increase from four to eight staff members.

The operating levels of 900 explosive tests, 1,250 chemical analyses, and 100 battery tests for the expanded alternative assume all labs are operating at full potential because of excellent success in Work For Others and Laboratory-Directed Research and Development initiatives.

5.3.2.3 Reduced

The reduced operating level for neutron generator tests would not be anticipated to drop below the 500 tests needed to support mission requirements.

The operating levels of 300 explosive tests, 500 chemical analyses, and 10 battery tests for the reduced alternative are sufficient only to maintain capabilities to provide support for nuclear weapon stockpile activities.

5.4 Advanced Manufacturing Processes Laboratory

5.4.1 Operations

The Manufacturing Technologies Center and specifically the Advanced Manufacturing Process Laboratory can prototype and do limited manufacture for many of the specialized components of nuclear weapons. Advanced manufacturing technology development in the Advanced Manufacturing Processes Laboratory is focused on enhancing SNL/NM's capability in four broad areas:

- Manufacture of engineering hardware
- Emergency and specialized production of weapon hardware

- Development of robust manufacturing processes
- Design and fabrication of unique production equipment

5.4.2 Alternatives

5.4.2.1 No Action

The characteristics of Advanced Manufacturing Processes Laboratory operations include numerous and diverse laboratories and capabilities and frequent changes in clients, production schedules, products, and processes. As a result, more preferable or traditional throughput parameters such as the numbers of tests or units produced are not useful for projecting Advanced Manufacturing Processes Laboratory activities over a multiple-year timeframe. Instead, annual operational hours have been used to project facility throughput or activity.

To determine Advanced Manufacturing Processes Laboratory operational activity levels, the 46-week work year was multiplied by a 40-hour workweek to derive the total number of work hours per year for one employee:

$$46 \text{ weeks per year} \times 40 \text{ hours per week} = 1,840 \text{ hours per year per employee}$$

That total was multiplied by the average number of scientific, technical, and facility personnel:

$$1,840 \text{ hours per year per employee} \times 135 \text{ employees} = 248,000 \text{ hours per year that the Advanced Manufacturing Processes Laboratory facility is in full operational mode within combined labs}$$

The results provide an estimated baseline of Advanced Manufacturing Processes Laboratory activity for 1996 to 1997.

The projections under the 2003 to 2008 no action alternative assume an increase in Work For Others and other program activity sufficient to require an estimated 34 additional employees or an increase of just over 25 percent in the total number of employees. This estimated increase would also result in an increase in facility operational hours of approximately 62,000 annually for a projected total of 310,000 annual operational hours.

5.4.2.2 Expanded

The projections under the expanded alternative assume an increase in Work For Others and other program activity sufficient to require an estimated 54 additional employees or an increase

of approximately 40 percent in the total number of employees. The addition of these extra personnel would require the facility to begin operating more than one shift per day.

This would also result in an increase in facility operational hours of approximately 99,000 annually for a projected total of 347,000 annual operational hours.

5.4.2.3 Reduced

The level of effort projected for the reduced alternative is identical to the base year number of 248,000 operational hours because the facility is currently operating at the minimum number of personnel (minus administrative staff) required to maintain operational capability in each of the various areas of expertise. Any lower level of effort would not provide the minimum support necessary to keep the facility responsive to the needs of DOE and other customers.

5.5 Integrated Materials Research Laboratory

5.5.1 Operations

The Integrated Materials Research Laboratory enables SNL/NM to develop new and superior material that meets government and industrial needs. This 140,000-ft² building houses most of the advanced material research and development functions at SNL/NM.

The research activities at the Integrated Materials Research Laboratory include lab studies in chemistry, physics, and alternative energy technologies. Material that is studied includes ceramics, organic polymers, alloys, and electronic components. The facility integrates research from the atomic scale through the development of electronic devices to full-scale mechanical components. The experimental work is augmented by advanced computer modeling and simulation techniques, which is another area of SNL/NM expertise.

5.5.2 Alternatives

5.5.2.1 No Action

The base year number for operational hours was derived by multiplying the number of scientific, technical, and facility workers in the Integrated Materials Research Laboratory by the number of hours worked by one employee during a year:

$$1,740 \text{ hours per year per employee} \times 227 \text{ employees} = 395,454 \text{ hours per year}$$

The projections under the no action alternative assume no change in level of operations because no reductions are anticipated and because the facility is already operating at its maximum capability.

It is not realistic to consider multiple shifts because laboratory space is limited. When a scientist sets up an experiment, the space cannot be used simultaneously for other purposes. Typically, equipment in a research and development setting is used for a single purpose 24 hours per day. This eliminates the option of considering multiple shifts.

5.5.2.2 Expanded

The level of activity in the Integrated Materials Research Laboratory is expected to be constant through the next ten years. Because the facility is currently working at its maximum capacity, no increase is anticipated. It is not realistic to consider multiple shifts in a research and development setting because a laboratory that is set up for a particular experiment cannot be used simultaneously for other purposes.

5.5.2.3 Reduced

Although the level of activity in the Integrated Materials Research Laboratory is expected to be constant through the next ten years, there may be a slight reduction in the number of personnel. Therefore, the level of effort projected for the reduced alternative is slightly lower than the base year number. This reduction would likely involve postdoctoral workers. Any reduction in the Integrated Materials Research Laboratory's core staff would imply a reduction in capabilities.

5.6 Physical Testing and Simulation Facilities

5.6.1 Sled Track Complex

5.6.1.1 Operations

The types of tests that can be performed at the Sled Track Complex include:

- **Impact Tests** - Test objects are built into expendable sled structures and rocket-accelerated into specific targets at the end of the sled track.
- **Reverse Ballistic Impact Tests** - Target material is built into expendable sled structures and rocket-accelerated to impact test objects at the end of the track.

- **Free-Flight Impact Tests** - Test objects are ejected from recoverable rocket sleds by pneumatic ejectors built into the sleds.
- **Function Tests** - Test objects are rocket-accelerated down the track on recoverable sleds, ejected from the sleds into free flight, or launched into free flight from portable launch rails to verify functions programmed to occur during the tests.
- **Parachute Tests** - Parachute tests are function tests in which the parachutes are deployed at specified dynamic pressures. Parachute deployments may also be a function during free-flight impact tests.
- **Rocket Launcher Impact Tests** - Test objects are rocket-accelerated down a beam on a carriage that is stopped at the end of the beam, allowing the test objects to free fly into specific targets at predetermined impact angles and velocities.
- **Explosive Effects Tests** - Explosive charges are detonated at an explosive firing site located south of the 10,000-ft sled track. The explosive detonations subject test objects to blast waves or propel missiles into test objects.

5.6.1.2 Alternatives

5.6.1.2.1 No Action

Under the no action alternative, four types of tests would continue to be conducted at the Sled Track Complex. These include rocket sled tests, explosive detonations, rocket launches, and free-flight launches.

The base year value for rocket sled tests is 10 tests. Current plans call for 10 rocket sled tests per year until 2003 and up to 15 rocket sled tests annually by 2008. The base year, 2003, and 2008 values for explosives tests are 12 explosive tests. The base year value for rocket launches is three launches for the base year and four launches for 2003 and 2008. The base year, 2003, and 2008 values for free-flight launch tests are 40 tests per year.

5.6.1.2.2 Expanded

The following lists the number and types of tests per year at the Sled Track Complex under the expanded alternative:

- 80 rocket sled tests
- 24 rocket launches
- 239 explosive tests
- 150 free-flight launches

These estimates are based on the facility manager's knowledge of operating capabilities.

5.6.1.2.3 Reduced

Under the reduced alternative, two rocket sled tests would be conducted, and there would be no other tests. The rocket sled tests are required because only these type tests necessitate the maintenance of complex technical capabilities to respond to short-term demand for increased activities.

5.6.2 Centrifuge Complex

5.6.2.1 Operations

The 29-ft indoor centrifuge subjects test packages that weigh up to 16,000 lb to acceleration forces of up to 100 times the acceleration of gravity and subjects lighter packages to acceleration forces of up to 300 times the acceleration of gravity.

The 35-ft outdoor centrifuge subjects objects that weigh up to 10,000 lb to acceleration forces of up to 240 times the acceleration of gravity. In impact tests, a small object is accelerated and released from the arm of the 35-foot centrifuge on a tangential trajectory to impact targets.

Typical payloads are weapons systems, satellite systems, reentry vehicles, geotechnic loads, rocket components, and sensing devices.

5.6.2.2 Alternatives

5.6.2.2.1 No Action

Under the no action alternative, Centrifuge Complex operations would include 32 centrifuge tests and no impact tests for the base year. Current plans call for up to 46 centrifuge tests and 10 impact tests per year by 2003 through 2008. The projected increases in activity forecasts acceleration testing for certification of joint test assemblies, weapon modifications, and Work for Others programs.

5.6.2.2.2 Expanded

Under the expanded alternative, the complex would be capable of 120 centrifuge tests annually and 100 impact tests annually. The historical record of activities from 1987 to 1996 included a peak year of 120 centrifuge tests. Managers of the complex believe that a reasonable estimate of expanded activities would be bound by this peak number of 120 centrifuge tests per year.

5.6.2.2.3 Reduced

At least two centrifuge tests would have to be conducted annually under the reduced alternative to maintain current testing capability. No impact tests would be required.

5.6.3 Drop/Impact Complex

5.6.3.1 Operations

The 185-ft drop tower is used to drop test items weighing up to 9,000 pounds onto prepared surfaces such as dirt, reinforced concrete, or a steel plate. It has a cable stretched over the top of the tower to anchors on the ground. Test items weighing up to 2,000 pounds can slide down these cables on a carriage that releases test items to fall to a target at specific angles. A guidewire system on the 185-ft drop tower is used to drop punch-type structural shapes to precise impacts on shipping containers.

Test items that weigh up to 3,000 pounds can be dropped into the water pool from the 300-ft drop tower. They can be dropped or accelerated by rocket-assisted pull-down to strike the water at velocities up to 600 ft per second and at angles from 30 to 90 degrees.

Submersion tests are conducted in the water pool. Explosive charges of up to 1 lb may be detonated under water for underwater blast effects.

5.6.3.2 Alternatives

5.6.3.2.1 No Action

Up to 20 drop tests would be conducted annually under the no action alternative, and only one water impact test would be conducted per year under this alternative. Likewise, only one submersion test is planned per year under the no action alternative, and up to two underwater blast tests would be conducted.

5.6.3.2.2 Expanded

The number of tests that could be conducted under the expanded alternative are 50 drop tests, 20 water impact tests, 5 submersion tests, and 10 underwater blast tests.

5.6.3.2.3 Reduced

Only a single water impact test would have to be conducted annually to maintain operational capability. The other tests could be mobilized in short order even if none were routinely conducted.

5.6.4 Terminal Ballistics Facility

5.6.4.1 Operations

Operations at the Terminal Ballistics Facility include the firing of all types of firearms, loading of ammunition, assembly of propellant charges, and the handling of explosives.

5.6.4.2 Alternatives

5.6.4.2.1 No Action

Under the no action alternative, the Terminal Ballistics Facility would continue projectile impact testing and propellant testing. For projectile impact testing, the base year value is 50 tests. The complex is expected to conduct 80 tests annually by year 2003, increasing to 100 tests annually by year 2008. For propellant testing, the base year value is 25 tests. The facility is expected to conduct 40 tests annually by 2003, increasing to 50 tests annually by year 2008.

The base year for impact testing at the Terminal Ballistics Facility is FY1997. Base year values for propellant testing are 1996 actuals. Projections for impact and propellant testing for 2003 and 2008 assume only minimal increases in activity and minimum additional success in Work For Others support and Laboratory-Directed Research and Development initiatives.

5.6.4.2.2 Expanded

The Terminal Ballistics Facility can conduct up to 350 projectile impact tests and 100 propellant tests annually. The expanded alternative assumes maximum utilization of the facility, which would include major increases in Work For Others support as well as a greater level of effort in support of Laboratory-Directed Research and Development initiatives.

5.6.4.2.3 Reduced

To maintain operational capability, a minimum of ten projectile impact tests and four propellant tests would be conducted each year. Projectile impact tests would include all calibers of projectiles, from small arms to the 155-mm gun. Propellant testing includes static thrust tests and tests of spin rockets.

Projections under this alternative assume maintenance of the minimum capability required to support ongoing development of the Safe Secure Transport, which is used for transport of nuclear weapons. Projections further assume little to no support to Work For Others programs and Laboratory-Directed Research and Development initiatives.

5.7 Accelerator Facilities

5.7.1 Operations

The operations and activities taking place in Tech Area IV are diverse. Although the dominant activity is related to pulsed power technology, other areas of activity include computer science, flight dynamics, satellite processing, and robotics. All Tech Area IV capabilities fall into the basic categories of scientific research, development, and testing. More specifically, these capabilities include the following:

- Ability to integrate experimentation and computational simulation in support of radiation effects testing, radiation transport, diagnostics, and analyses to certify that electronic components and weapons systems will operate in hostile radiation environments over time as the stockpile ages.
- Reliability, survivability, and performance testing of nuclear weapon systems by generating short bursts of x-rays and gamma rays to simulate environments that would be produced by nuclear weapon detonation.
- Advanced materials research, development, testing, and evaluation through studies of x-rays effects in test materials and electronics.
- Weapons and defense systems improvements.

- Physical simulations of conditions (for example, exoatmospheric environments) to evaluate the design and development of navigation, guidance, and control systems that enhance both the accuracy and survivability of nuclear weapon delivery systems.
- Research on robots that are vital in the manufacture of new nuclear weapon components and the cleanup of radioactive and hazardous waste at former DOE nuclear weapons sites.
- Research facilities to enhance satellite surveillance capabilities in hostile radiation environments, whether encountered in space or created by nuclear detonations.
- Research and development of new commercial and defense-related applications, such as material processing, waste and product sterilization, mine detection, and food purification.
- Advanced pulsed power development, including the design and qualification of pulsed power components, target diagnostics, and the operation, maintenance, and technology advancement of pulsed power facilities.
- Characterization and demonstration of the utility of pulsed power-generated soft x-ray sources for weapons physics and inertial confinement fusion experiments to ensure the reliability and performance of nuclear weapons without underground testing.

5.7.2 Alternatives

5.7.2.1 Z Machine

5.7.2.1.1 No Action

For the no action alternative, the Z Machine is anticipated to operate at close to full capacity, engaging in target and wire-array shots and continuing support to DOE programs and major initiatives over a 42-week operational year. This level of effort assumes two to three shifts over a five-day workweek and would result in an estimated 300 shots per year for the Z Machine accelerator during the 2003 and 2008 timeframes. This level of effort would be 200 percent of the operations from the average 1996-1997 base year levels of 150 shots per year. Z Machine operations for the 2003 and 2008 timeframes would be allocated to the following activities:

- A projected 165 accelerator firings per year, or approximately 55 percent of total operations, representing a new set of activities that use tritium (50 shots), deuterium (75 shots), plutonium-239 (20 shots), and depleted uranium (20 shots). Z Machine operations in this

area would support experimental activities on the response of materials, components, and subsystems to cold and warm x-ray radiation in simulated exoatmospheric threat conditions.

- An additional 135 accelerator firings per year, or approximately 45 percent of total operations, to support the following:
 - Performance Assessment Science and Technology Program development of advanced pulsed power sources for weapons effects testing and weapons physics experiments.
 - Inertial Confinement Fusion Program studies involving pulse-shaping, radiation flow, equation of state and opacity measurements, hydrodynamic instabilities, capsule implosion physics, and the production of thermonuclear neutrons using deuterium.
 - Continued Advanced Pulsed Power Technology Program tests to provide high-temperature, large-volume hohlraums and cold x-ray environments for weapons physics and internal confinement fusion applications.

5.7.2.1.2 Expanded

Under the expanded alternative, the Z Machine would operate seven days per week, firing an estimated 350 times per year. Of these, approximately 275 shots per year (approximately 78 percent) would involve the nuclear materials testing identified in the no action alternative. The remaining 75 shots per year (approximately 22 percent) would support other activities of the Experimental Activities Program, Performance Assessment Science and Technology Program, Inertial Confinement Fusion Program, and Pulsed Power Technology Program. This level of effort assumes at least two to three shifts over the five-day workweek and could require additional personnel or shifts.

5.7.2.1.3 Reduced

Under the reduced alternative, the Z Machine would operate at the minimum level required to maintain operational capability. This would require the support of minimum staff to fire the accelerator an estimated 84 times per year or approximately twice per week over the 42-week operational year.

5.7.2.2 HERMES III

5.7.2.2.1 No Action

An estimated 500 shots per year are expected for the HERMES III accelerator for the 2003 and 2008 projections under the no action alternative. This level of activity is 190 percent of the 1997 base year level of operations of 262 shots. The no action alternative assumes one shift per day during a five-day workweek over a 40-week per year schedule.

5.7.2.2.2 Expanded

Under the expanded alternative, the highest number of shots for HERMES III between now and 2008 is estimated at 1,450 shots. To reach projections under the expanded alternative, an increase in the operational work year above 40 weeks would be required through the addition of workdays or shifts.

5.7.2.2.3 Reduced

Under the reduced alternative, HERMES III would be fired about once per week to keep the accelerator in a state of operational readiness or 40 shots per year based on 40 weeks of annual operation.

5.7.2.3 Saturn

5.7.2.3.1 No Action

Projections under the no action alternative include an estimated 200 shots per year or more than 300 percent of the 1997 base year activity of 65 shots. Estimates for this level of accelerator activity include support in the development and survivability testing of nuclear weapon subsystems and components through the testing of the survivability of nuclear weapon systems by simulating the x-rays produced by a nuclear weapon detonation. Firing of Saturn supports research that simulates x-ray radiation effects of nuclear weapons on nonnuclear components of U.S. strategic systems.

5.7.2.3.2 Expanded

Under the expanded alternative, Saturn could operate at the Cold War level of activity of approximately 500 shots per year.

5.7.2.3.3 Reduced

Under the reduced alternative, Saturn would need to be fired approximately once per week to maintain the accelerator in a state of operational readiness (40 shots over the 40-week operating year).

5.7.2.4 Repetitive High Energy Pulsed Power Unit I

5.7.2.4.1 No Action

The Repetitive High Energy Pulsed Power Unit I would be used for an estimated 5,000 tests or treatments per year over the 40-week operational work year for the 2003 and 2008 timeframes. This level of effort is 1,000 percent of the average 1996-1997 base year levels of 500 shots per year. The Repetitive High Energy Pulsed Power Unit I fires at 10 Hz (10 pulses per second). The number of shots associated with a test could go as high as 1,000 pulses, or 100 10-Hz tests. The tests projected under the no action alternative would be in both the single- and repetitive-pulse modes. The ratio of single-pulse to repetitive-pulse mode would vary depending on user preference.

5.7.2.4.2 Expanded

Under the expanded alternative, the Repetitive High Energy Pulsed Power Unit I would operate at the maximum level at which the facility could reasonably be anticipated to perform. The tests projected under this alternative would be in both the single- and repetitive-pulse modes and would require an estimated 10,000 shots per year (50 tests per day or 250 tests per week over the 40-week operational year).

5.7.2.4.3 Reduced

Under the reduced alternative, the Repetitive High Energy Pulsed Power Unit I would fire approximately 100 times per year, which is the minimum number of times annually needed to maintain assurance of operational capability in both the single- and repetitive-pulse modes.

5.7.2.5 Repetitive High Energy Pulsed Power Unit II

5.7.2.5.1 No Action

During the 2003 and 2008 timeframes, the Repetitive High Energy Pulsed Power Unit II is expected to be used for approximately 160 tests per, which is 200 percent of the 1996 base year level of 80 tests per year.

5.7.2.5.2 Expanded

Under the expanded alternative, the Repetitive High Energy Pulsed Power Unit II facility would operate at the maximum anticipated capacity for the facility. Testing projections under this alternative would take place at the rate of four tests per day or 800 tests annually based on a 40-week operational year.

5.7.2.5.3 Reduced

Under the reduced alternative, testing would take place at the rate of 40 tests annually based on a 40-week operational year, which is the minimum level of activity required to maintain operational capability at the facility.

5.7.2.6 Sandia Accelerator and Beam Research Experiment

5.7.2.6.1 No Action

For projections under the 2003 and 2008 timeframes of the no action alternative, the highest expected number of shots per year for the Sandia Accelerator and Beam Research Experiment (SABRE) accelerator is 225 shots, which is approximately 120 percent of the 1997 base year activity of 187 shots.

5.7.2.6.2 Expanded

Under the expanded alternative, SABRE would fire two shots per day during a five-day work week over a 40-week work year (400 shots per year).

5.7.2.6.3 Reduced

Because SABRE is a relatively small facility (about 5 percent of the size of HERMES III), the amount of time spent to restart the accelerator under the reduced alternative would be essentially the same whether SABRE is fired a minimal number of times per year or not at all. Therefore, SABRE would not need to be operated to keep the accelerator in a state of “near” operational readiness.

5.7.2.7 Short-Pulse High Intensity Nanosecond X-Radiator

5.7.2.7.1 No Action

Under the 2003 and 2008 projections of the no action alternative, a maximum of 2,500 shots per year are expected for the Short-Pulse High Intensity Nanosecond X-Radiator (SPHINX). The 1997 base year value is 1,185 shots.

5.7.2.7.2 Expanded

The SPHINX would be expected to fire 6,000 shots per year under the expanded alternative. To reach projections under the expanded alternative, an increase in the operational work year would be required through the addition of workdays or multiple shifts.

5.7.2.7.3 Reduced

Under the reduced alternative, the SPHINX accelerator would need to be operated approximately once per day to keep the accelerator in readiness. The minimal level of activity for the accelerator is estimated at 200 shots per year based on a 40-week operational year.

5.7.2.8 TESLA

5.7.2.8.1 No Action

For the 2003 and 2008 projections under the no action alternative, TESLA is anticipated to function at near full capacity of approximately 1,000 shots per year over the 40-week operational year. TESLA was not operational during 1996 and was fired a total of 10 times during all of 1997.

5.7.2.8.2 Expanded

Activity at the TESLA accelerator is projected at 1,300 shots per year for the expanded alternative.

5.7.2.8.3 Reduced

The TESLA facility requires 40 shots per year to maintain the facility's operational capability or one shot each week of a 40-week operational year.

5.7.2.9 Radiographic Integrated Test Stand

5.7.2.9.1 No Action

Because the Radiographic Integrated Test Stand is a planned rather than an existing facility, the base year level of operation under the no action alternative is zero. Projections for 2003 and 2008 indicate an increase in Radiographic Integrated Test Stand operations from 400 shots per year over the five-year horizon (2003) to 600 shots per year over the ten-year horizon (2008).

5.7.2.9.2 Expanded

Under the expanded alternative, projections for the Radiographic Integrated Test Stand assume full operational capacity of 800 shots per year (20 shots per week over 40 weeks). The ratio of explosives to pulsed power shots is anticipated to be the same as that projected under the no action alternative (approximately 3 percent explosives shots to 97 percent pulsed power shots).

5.7.2.9.3 Reduced

Projections under the reduced alternative of 100 shots over 40 weeks assume the minimum level of operations to maintain operational capability in both the pulsed power and explosives modes. The ratio of explosives to pulsed power shots would be the same as that indicated under the no action and expanded alternatives (approximately 3 percent explosives shots to 97 percent pulsed power shots).

5.7.2.10 Advanced Pulse Power Research Module

5.7.2.10.1 No Action

The Advanced Pulse Power Research Module accelerator would fire 1,000 times per year over each 40-week operational year according to 2003 and 2008 projections, which is 200 percent of the 1997 base year level of 500 shots per year.

5.7.2.10.2 Expanded

Projections under the expanded alternative for the Advanced Pulse Power Research Module assume an increased activity level of 2,000 shots per year or 50 shots per week over 40 weeks.

5.7.2.10.3 Reduced

Under the reduced alternative, the Advanced Pulse Power Research Module facility would fire only 40 times per year or once per week over the 40-week operational year to maintain operational capability.

5.8 Reactor Facilities

5.8.1 Sandia Pulsed Reactor

5.8.1.1 Operations

The Sandia Pulsed Reactor Facility houses SNL's fast-burst reactor assemblies, SPR-II and SPR-III. The reactors and reactor-critical experiments provide unique near-fission spectrum radiation environments for testing a wide variety of technologies that support both defense and nondefense activities.

5.8.1.2 Alternatives

5.8.1.2.1 No Action

The no action alternative assumes that the Sandia Pulsed Reactor Facility will operate at nearly full capacity for a single shift operation of 100 tests per year. This assumption is based on actual facility operations involving the SPR-II and SPR-III reactors during the baseline years of 1996 and 1997. These operations include tests that range from activities that require a few hours to set up and complete to more extensive experiments that may require more than a month to complete. The annual level of activity is projected to remain constant from the base year through 2008.

The SPR-IIIM reactor assembly has been constructed but has not yet been fueled. Facility personnel anticipate that the uranium fuel will be available before FY2003. The no action alternative assumes that a new, next generation reactor (generically referred to as SPR-IV) will become operational in the 2004 to 2008 timeframe to meet Defense Program mission requirements. A reactor-critical experiment may be conducted in the facility during this period. The SPR-IIIM and SPR-IV reactors would share the existing Sandia Pulsed Reactor Kiva in the same manner that the current reactors and past critical assemblies have shared this facility.

The Sandia Pulsed Reactor Facility may also support other operations that require enhanced security for significant quantities of special nuclear materials. Under all of the no action timeframes, less than five such activities are assumed for each year.

5.8.1.2.2 Expanded

The expanded alternative for testing activities at the Sandia Pulsed Reactor Facility (all reactors combined), assumes operation at full capacity with two shifts, which would support approximately 200 tests per year and which would require additional staff with respect to staffing under the no action baseline.

The Sandia Pulsed Reactor Facility may also be used to conduct other operations that require enhanced security for significant quantities of special nuclear materials. Under the expanded alternative, less than 20 such activities are projected for each year.

5.8.1.2.3 Reduced

The reduced alternative for testing at the Sandia Pulsed Reactor Facility assumes that 30 tests would be conducted to keep the facility operational. While testing would be reduced, some test operations would still be required to maintain the facility in a state of operational readiness.

5.8.2 Annular Core Research Reactor Facility

5.8.2.1 Operations

Historically, the Annular Core Research Reactor Facility has been used to support a variety of tests for customers such as DOE Office of Defense Programs and the Nuclear Regulatory Commission. Recently, the Annular Core Research Reactor Facility mission has changed to provide a production capability for medical radioisotopes, which prompted recent modification of the facility to a configuration suitable for that purpose.

5.8.2.2 Alternatives

5.8.2.2.1 Defense Program Activities

No Action - The no action alternative assumes that a single DOE Office of Defense Programs (DP) test in the existing Annular Core Research Reactor Facility is required at some point in the future to respond to a national emergency. This test will be conducted in the existing Annular Core Research Reactor Facility, which would have to be temporarily reconfigured to restore testing capability. During this time, medical isotope production would be interrupted. Following

this DP test, the Annular Core Research Reactor configuration would return to that required for isotope production.

Expanded - The expanded alternative assumes that there will be an ongoing need for DP testing in an Annular Core Research Reactor Facility. To meet this need, an additional Annular Core Research Reactor Facility would be reconstituted using the same fundamental design as the existing Annular Core Research Reactor Facility. The expanded alternative for DP testing in the Annular Core Research Reactor assumes approximately two or three test campaigns (consisting of several individual tests) for each year.

Reduced - No DP test activities are planned under the reduced alternative. The reduced alternative assumes that there are no DP tests conducted, neither in a reconfigured nor in a new reconstituted Annular Core Research Reactor Facility.

5.8.2.2.1 Mo-99 Production Activities

No Action - Under the no action alternative, the Annular Core Research Reactor would operate for 52 weeks to irradiate targets to produce approximately 30 percent on average of the U.S. demand for Mo-99 and other isotopes such as I-131, Xe-133, and I-125. The 2003 and 2008 estimates assume that the SNL/NM medical isotope production program operates primarily as a backup to Nordion, Inc., the current supplier for the U.S. market, at a nominal 30 percent of the U.S. level of demand. This would require the irradiation of about seven irradiated highly-enriched uranium targets per week (375 per year). Eight targets were irradiated at the facility during the base year (calendar year [CY] 1996).

A single DP test may be required at some point in the future to respond to a national emergency. This test would be conducted in the existing Annular Core Research Reactor Facility, which would have to be temporarily reconfigured to restore testing capability. During this time, medical isotope production would be interrupted. Following this DP test, the Annular Core Research Reactor configuration would return to that required for isotope production.

Expanded - The Annular Core Research Reactor would be operated for 24 hours per day, seven days per week at a maximum power level of 4 MW (approximately 35,000 MW-hours per year) to meet the entire U.S. demand for Mo-99 and other isotopes such as I-131, Xe-133, and I-125 in the expanded alternative. This would require the irradiation of about 25 highly enriched uranium targets per week (1,300 per year).

Reduced - The Annular Core Research Reactor would irradiate the minimum number of targets (40 targets per year) to maintain the facility, staff, processes, and material inventories that are necessary to restart production activities on short notice in the reduced alternative. The facility

would require operation for approximately eight hours per day for 24 weeks (a single operational shift for two weeks each month for approximately 1,000 hours of operation per year) at a maximum power level of 4 MW (approximately 4,000 MW-hours per year).

5.8.3 Hot Cell Facility

5.8.3.1 Operations

The Hot Cell Facility is a specially designed and constructed facility that allows remote handling and manipulation of radioactive materials. To provide this capability, the facility features specially designed ventilation systems, shielded work zones, remote manipulators, and other specialized systems. The Hot Cell Facility is currently being modified so that it can be utilized to extract and purify radioisotopes that will primarily be used to perform medical diagnostics, therapy, and research.

5.8.3.2 Alternatives

5.8.3.2.1 No Action

The Hot Cell Facility is expected to process approximately 30 percent of the U.S. demand for Mo-99 and other isotopes such as I-131, Xe-133, and I-125 over the 2003 and 2008 timeframes. To do so, the facility would process approximately seven irradiated highly enriched uranium targets per week (375 targets per year). Varying production needs may require varying operating levels that would range from periods of shutdown to periods of operation at 100 percent of the U.S. demand level (approximately 25 targets per week). However, the annual total is not anticipated to exceed approximately 1,300 targets processed in a particular year. The base year value of eight targets indicates the series of tests and experiments that were conducted in CY1996.

5.8.3.2.2 Expanded

Under the expanded alternative, the Hot Cell Facility would continuously process 100 percent of the U.S. demand for Mo-99 and other isotopes such as I-131, Xe-133, and I-125, which would require the processing of approximately 25 irradiated highly enriched uranium targets per week (1,300 per year).

5.8.3.2.3 Reduced

Under the reduced alternative, the Hot Cell Facility would process the minimum number of targets (40 targets per year) to maintain the facility, staff, processes, and material inventories that are necessary to restart production activities on short notice.

5.8.4 Gamma Irradiation Facility

5.8.4.1 Operations

The Gamma Irradiation Facility houses gamma radiation sources and uses a wet storage pool and specially designed, room-sized cells with remote manipulators to provide high intensity gamma radiation for radiation environment testing of materials, components, and systems.

5.8.4.2 Alternatives

5.8.4.2.1 No Action

The no action alternative for testing in the Gamma Irradiation Facility assumes that the facility would irradiate test packages in one of the two available test cells for 1,000 test hours (approximately 40 days of continuous irradiation in each of the two cells) per year. The new Gamma Irradiation Facility is assumed to be operational prior to 2003; therefore, the existing facility is assumed to be operational only during the base year of the no action alternative.

5.8.4.2.2 Expanded

The expanded alternative for testing at the Gamma Irradiation Facility assumes that the facility would irradiate test packages for 8,000 test-hours per year (approximately 165 days of continuous irradiation in a single cell). The effect of the expanded alternative relative to the no action base year would be an increased level of staffing.

5.8.4.2.3 Reduced

The reduced alternative assumes that testing at the Gamma Irradiation Facility would drop to zero when test activity would be transferred to the new Gamma Irradiation Facility. The effect of the reduced alternative relative to the base year would include a slightly reduced level of staffing.

5.8.5 New Gamma Irradiation Facility

5.8.5.1 Operations

The new Gamma Irradiation Facility will replace the existing Gamma Irradiation Facility and will consolidate several existing SNL/NM gamma sources into a single facility. It will provide a modern facility to satisfy SNL's continued need for high-intensity gamma environment testing for the foreseeable future.

5.8.5.2 Alternatives

5.8.5.2.1 No Action

The no action alternative for testing at the new Gamma Irradiation Facility assumes that the facility would irradiate test packages in one of the available test cells for 13,000 test-hours per year (26 weeks continuous irradiation in each of three cells). Because this facility would be constructed after the no action baseline timeframe, the no action alternative assumes that the facility is operational during for the 2003 and 2008 timeframes only.

5.8.5.2.2 Expanded

The expanded alternative for testing at the new Gamma Irradiation Facility assumes that the facility irradiates test packages in one of the two available test cells for a total of 24,000 test-hours per year (approximately 330 days of continuous irradiation in three cells). The impact of the expanded scenario relative to the baseline is an increased level of staffing.

5.8.5.2.3 Reduced

The reduced alternative for testing in the new Gamma Irradiation Facility assumes that the facility does not irradiate test packages. The effect of the reduced scenario relative to the base year is a slightly reduced level of staffing.

5.9 Outdoor Test Facilities

5.9.1 Aerial Cable Facility Complex

5.9.1.1 Operations

The Aerial Cable Facility Complex provides the following capabilities:

- Precision testing of airborne sensors and sensor-fuzed weapons systems suspended in a stable platform above the ground targets
- Precision testing of ground-based sensors and target acquisition devices directed against captive flight of simulated and aircraft targets traversing the facility cableways
- Evaluation of the effectiveness of heat-seeking threat missiles through field and computer integrated tests
- Impact velocity tests controlled by computer modeling trajectories to determine optimal rocket motor impulse and release position to yield desired impact velocities and angles
- Weapon component validation through periodic drop tests of joint test assemblies and other system components
- Proof of firing experiments through air-to-ground ordnance testing
- Tests of unguided missiles on ballistic trajectories
- Tests of guided missiles that utilize several techniques for tracking, lock-on, and guidance toward the target
- Remote firing artillery operations to determine scoring capabilities

5.9.1.2 Alternatives

5.9.1.2.1 No Action

Projections for each alternative for the Aerial Cable Facility Complex are based on three primary activities:

- Drop and pull-down tests
- Aerial target tests
- Scoring system tests

The base year value for drop and pull-down tests is 21 tests; this value is projected to increase to 32 tests by FY2003 and to 38 tests by FY2008. These estimates assume an increase in support to the certification of weapon modifications, joint test assemblies, and transportation packages; design verification for transportation technology; and work for outside agencies.

Projections under the no action alternative for aerial target tests assume a continuation of the level of activity identified for the 1996 base year, which is six tests.

Scoring system testing did not take place during either 1996 or 1997; as a result, no base year value was available. Projections for this activity during the 2003 and 2008 no action timeframes assume a single test series.

5.9.1.2.2 Expanded

The projection under the expanded alternative for drop and pull-down test activities indicates the numbers of tests that the complex could reasonably expect to accommodate in an expanded mode of operations, which is 100 tests. This projection assumes an increase in weapon modifications, joint test assemblies, and container recertifications, and it also assumes additional support to Energy Programs, outside agencies, and weapons research programs.

The expanded alternative projection for 30 aerial target test activities also represents an estimate by the managers of the complex of the number of tests that the complex could accommodate in an expanded mode of operations.

Because scoring system testing does not occur frequently, the projection for this activity under the expanded alternative is limited to two individual test series.

5.9.1.2.3 Reduced

The projection for two drop and pull-down tests under the reduced alternative represents the minimum level of activity required to maintain test capability. Reductions of activities to this level would require a large reduction in or discontinuation of weapon modification testing and testing of joint test assemblies and a discontinuation of support to Energy Programs and outside agencies.

The projection for no aerial target testing under the reduced alternative assumes a temporary discontinuation of the activity. This activity is conducted on an as-needed basis, and actual testing is not required to maintain capability. However, technical skills and equipment would need to be kept current in order to resume testing within a reasonable startup time.

Similarly, the projection under the reduced alternative for no scoring system testing also assumes a temporary discontinuation of the activity. Actual testing is not required to maintain capability; however, skills and equipment would need to be kept current in order to resume testing within a reasonable startup time.

5.9.2 Lurance Canyon Burn Site

5.9.2.1 Operations

The Lurance Canyon Burn Site provides the following capabilities:

- Enclosed fire testing and fire suppression testing to evaluate the effectiveness of proposed nontoxic and nonpolluting suppressants
- Propellant and wood fire testing in cleared areas to evaluate the vulnerability of weapons and satellites during accident scenarios (for example, missile fire on a launch pad)
- Open pool fires of fuels for simulation of transportation accidents during certification testing
- Fuel-air mixture testing to qualify electronic equipment to National Electrical Code standards
- Wood fire or crib testing to satisfy U.S. Department of Transportation (DOT) requirements for shipping containers for explosive components

5.9.2.2 Alternatives

5.9.2.2.1 No Action

Projections for the Lurance Canyon Burn Site are provided for three primary activities, which are certification testing, model validation, and user testing. For the no action alternatives, no change in the levels of these activities is expected over the coming ten years with respect to base year values, which are 12 certification tests, 56 model validation tests, and 37 user tests.

5.9.2.2.2 Expanded

Fifty-five certification tests annually are projected for the expanded alternative, assuming an increase in certification testing of weapon modifications and an increase in work for Energy Programs, outside agencies, and weapons research programs. The expanded alternative

projection for model validation support is 100 tests per year, and the expanded projection for user testing is 50 tests per year.

5.9.2.2.3 Reduced

The projection of a single certification test under the reduced alternative represents the minimum level of activity required to maintain the viability of the facility. Actual testing is not required to maintain capability; however, technical skills and equipment would need to be kept current in order to resume testing within a reasonable startup time. This reduced level of activity would likely only occur as a result of the severe reductions or discontinuations of certification testing for weapon modifications, model validation activity, and support to Energy Programs and work for outside agencies.

Projections for model validation and user testing under the reduced alternative assume a discontinuation of the activities. Actual testing is not required to maintain the capabilities; however, technical skills and equipment would need to be kept current in order to resume the activities within a reasonable startup time.

5.9.3 Containment Technology Test Facility

5.9.3.1 Operations

The purpose of the Containment Technology Test Facility is to test prestressed concrete containment structures and steel containment to failure. This facility was developed exclusively for support to the Nuclear Regulatory Commission's test reactor containment building research.

5.9.3.2 Alternatives

5.9.3.2.1 No Action

The Containment Technology Test Facility was constructed specifically for two survivability tests, the first of which was completed in fiscal year (FY) 1997. The second and final test is scheduled for completion in FY2000. Because there are no plans for additional testing following completion of the second test, the projections under this alternative are limited to a single event.

5.9.3.2.2 Expanded

The current program activity, which involves two overlapping test cycles, is the facility's maximum capacity.

5.9.3.2.3 Reduced

To maintain technical capability, at least one test would be required during each annual research cycle. The time from initiating planning to completion of the test would be six years for most testing efforts.

5.9.4 Explosives Applications Laboratory

5.9.4.1 Operations

The Explosives Applications Laboratory provides the following capabilities:

- Developmental testing in support of arming, fuzing, and firing of explosives systems and components through low-voltage testing of electronic circuits
- Intermediate- and high-voltage circuitry testing of firesets
- X-ray analysis of systems operating at 150,000 volts (V) or 300,000 V
- Automatic film processing and production of limited amounts of black and white still photography prints as part of x-ray analysis
- Fabrication of small numbers of electronic assemblies (primarily soldering and cleaning of circuitry)
- The handling and assembly of explosive experiments

5.9.4.2 Alternatives

5.9.4.2.1 No Action

Projections under the no action alternative for explosives testing assume 240 tests annually, which is the same or a similar level of activity as that of the 1996 base year.

5.9.4.2.2 Expanded

Estimates of the level of activity under the expanded alternative range from 275 to 360 tests, which is the facility's maximum capacity. Additional expenditures would be required, and personnel requirements would double from that of the no action alternative.

5.9.4.2.3 Reduced

Maintaining the site capability and qualifications of firing officers and personnel requires approximately 50 tests per year to ensure that personnel maintain minimum qualifications for arming, fusing, and firing of explosives and explosives components. Any reductions in staffing under this alternative would likely only entail a reduction of one or less (for example, substitution of a part-time employee for a full-time employee).

5.9.5 Thunder Range Complex

5.9.5.1 Operations

Operations at The Thunder Range Complex include the following:

- Development, safety, reliability, and certification testing of AEC/DOE weapon systems, including simulation of extremely harsh environments during storage, transportation, or use
- Ground truthing testing to support observational fly-overs
- DOD explosive tests of anti-armor warheads, tests of foreign rocket motors, and enactment of terrorist scenarios
- Safety certification tests of spacecraft batteries
- Evaluation and physical examination, cleaning, mechanical disassembly, physical measurement, sampling, and photography of all components and systems prior to return to test sponsors

5.9.5.2 Alternatives

Thunder Range Complex projections are provided for two primary activities, which are equipment disassembly and evaluation and ground truthing tests.

5.9.5.2.1 No Action

Examination of objects in support of equipment disassembly and evaluation activities is done on an as-needed basis. The site may be used continuously for 30 to 60 days once per year for this activity or used only one to two days per month throughout the year. Projections for the no action alternative for equipment disassembly and evaluation are derived from a base year

activity level of approximately 60 days of operation, representing one longer campaign and six shorter (1 to 2 day) campaigns. A slight increase in equipment disassembly and evaluation work is expected under the no action alternative with respect to the 1996 base year because 1996 was a time of transition from the prior functions of the facility to its present functions. These projections assume that for each of the years in the 2003 and 2008 timeframes there would be one 60-day campaign and 12 campaigns of 2 days for a total of 82 days per year.

Projections under no action alternative for ground truthing tests assume an annual increase in this activity from the base year value of one test to five tests per year by the 2003 and to eight tests per year by 2008. These projections are based on a slight increase in the number of observation fly-over events and are consistent with the experience of previous years.

5.9.5.2.2 Expanded

The expanded alternative for equipment disassembly and evaluation assumes a moderate increase in workload requiring two 60-day campaigns and twelve 2-day campaigns per year, for a total of 144 days per year. The projection for ground truth testing for the expanded alternative is 10 test series per year.

5.9.5.2.3 Reduced

The reduced alternative for equipment disassembly and evaluation assumes that in order to maintain the capability for this work at the Thunder Range Complex, one 30-day campaign and six two-day campaigns would be required per year, for a total of 42 days per year. The reduced alternative for ground truthing tests assumes that one test series per year would be needed to maintain test capability.

5.10 Infrastructure Facilities

5.10.1 Steam Plant

5.10.1.1 Operations

The Steam Plant in Building 605 has five operational boilers with supporting systems that supply steam to Tech Area I, DOE, and U.S. Air Force buildings from Eubank to Pennsylvania and from O Street to the Wyoming Boulevard Kirtland Air Force Base (KAFB) gate. The Steam Plant operates 24 hours per day, 365 days per year and has been in continuous operation since 1949.

5.10.1.2 Alternatives

5.10.1.2.1 No Action

During the base year, the Steam Plant produced 544 million lb of steam. Projections for 2003 and 2008 assume similar steam requirements because of an offset of growth by the elimination of an equivalent amount of area heated by steam.

5.10.1.2.2 Expanded

Steam generation for the expanded alternative assumes no change in the balance of steam requirements from that of base year.

5.10.1.2.3 Reduced

Steam generation for the reduced alternative assumes a 30 percent reduction in steam requirements from that of base year to 362 million lb per year. The 30 percent reduction is based on the potential for decline in customer needs, especially with regard to U.S. Air Force (USAF) requirements, and the maintenance of operational capability. This level of operation cannot be considered under the no action alternative because it is not yet planned or authorized.

5.10.2 Hazardous Waste Management Facility

5.10.2.1 Operations

The Hazardous Waste Management Facility is a permitted waste management facility located just south of Tech Area I in a small complex of buildings designed for short-term storage of waste while the waste is prepared for shipment. The facility manages most types of chemical waste generated at SNL/NM as well as waste generated by SNL/NM at a few offsite locations in Albuquerque (for example, the Advanced Materials Research Laboratory on the University of New Mexico campus). Stored wastes are segregated according to hazard, aggregated, packaged, and shipped to permitted offsite treatment and disposal facilities. Some waste types are segregated and shipped for recycling. No radioactive or explosive waste is accepted at the Hazardous Waste Management Facility, and waste is not stored for more than one year on site. Shipments to permitted offsite treatment, recycle, or disposal facilities occur at least monthly.

5.10.2.2 Alternatives

5.10.2.2.1 No Action

The 1996 base year value of 193,000 kg is based on the actual waste quantity shipped, which includes waste regulated by *Resource Conservation and Recovery Act (RCRA)* Subtitle C and the *Toxic Substances Control Act (TSCA)* but which does not include RCRA Subtitle D waste, medical waste, or explosive waste.

SNL/NM expects waste quantities to decrease slightly from the base year and flatten out past 1999. For 2003 and 2008, 103,700 kg of waste are projected based on historical trending and anticipated volumes from SNL/NM activities. The expected decline in waste volume is due to numerous factors, including changing missions, activities that favor modeling, decreased field activities, and waste minimization efforts.

5.10.2.2.2 Expanded

The highest expected volume of waste that could be processed at the Hazardous Waste Management Facility is approximately 579,000 kg, which is three times the base year value and which assumes three shifts of operations. The rate at which waste can be processed under the expanded alternative is less than that allowed within the confines of the current permit because the throughput of the Hazardous Waste Management Facility is limited to the amount of activity that can feasibly take place at any given time. The maximum capacity of each storage building is based on the secondary containment capacity in each building and stacking configuration.

The volume of waste that the Hazardous Waste Management Facility processes is driven by activities of SNL line organizations and not by any action the Hazardous Waste Management Facility has control over.

5.10.2.2.3 Reduced

The value for the reduced alternative for waste handling is 172,922 kg. The Hazardous Waste Management Facility capability will be maintained through the life of the current permit. Waste is not required to maintain the capability of the permit; however, the conditions of the permit, including facility inspections, and corporate policy, including maintenance of operational procedures and conduct of safety inspections, must continue to be met.

5.10.3 Radioactive and Mixed Waste Management Facility

5.10.3.1 Operations

The Radioactive and Mixed Waste Management Facility manages radioactive waste generated at SNL/NM. Specifically, the Radioactive and Mixed Waste Management Facility manages low-level radioactive waste, transuranic waste, low-level mixed waste, and transuranic mixed waste. At the Radioactive and Mixed Waste Management Facility, waste is characterized, sorted, and packaged for shipment to DOE-designated treatment or disposal facilities. The facility also stores waste until it can be approved for shipment off site.

Some waste streams are treated at the Radioactive and Mixed Waste Management Facility; treatment processes include neutralization, stabilization, compaction, evaporation of nonhazardous waste, mechanical processing, and other processes.

5.10.3.2 Alternatives

5.10.3.2.1 No Action

The base year values for waste management activities at the Radioactive and Mixed Waste Management Facility were calculated using data from August 1, 1996 through July 30, 1997. During that time, the Radioactive and Mixed Waste Management Facility shipped 1,631,876 lb of low-level radioactive waste at a volume of 22,843 ft³ and 593 lb of low-level mixed waste at a volume of 7 ft³ for a total of 1,632,469 lb of waste at a total volume of 22,850 ft³. No transuranic waste was shipped during the base year.

Base year operations included 2,582 shipments to offsite facilities from the Radioactive and Mixed Waste Management Facility. A “shipment” is defined as a parcel sent to an offsite disposal facility. Any onsite transfer is excluded from being defined as a shipment.

All waste that is picked up but not shipped off site is maintained under the control of the Radioactive and Mixed Waste Management Facility and is accounted for in the Radioactive and Mixed Waste Management Facility inventories.

Projections for years 2003 and 2008 assume that the facility will manage 2,122,209 lb of waste. The total number of shipments would increase proportionally during this timeframe. The 2003 and 2008 projections assume that transuranic waste could be shipped; however, the quantities are expected to be small.

5.10.3.2.2 Expanded

The highest expected volume of waste that would be processed at the Radioactive and Mixed Waste Management Facility is 2,693,573 lb of waste. Because the throughput of the Radioactive and Mixed Waste Management Facility is limited to the amount of activity that can feasibly take place at any given time, the rate of waste processing under the expanded alternative is less than that allowed within the restrictions of the current permit application. The quantity of waste for processing at the Radioactive and Mixed Waste Management Facility is driven by other SNL/NM activities, not by any action the Radioactive and Mixed Waste Management Facility has control over.

5.10.3.2.3 Reduced

Continued operation of the Radioactive and Mixed Waste Management Facility is necessary for the handling of SNL/NM radioactive wastes that other SNL/NM operations generate. The amount of waste processed in the reduced alternative is 816,234 lb, which would allow the Radioactive and Mixed Waste Management Facility to maintain compliance with permit application requirements.

5.10.4 Thermal Treatment Facility

5.10.4.1 Operations

Explosive waste that cannot readily be shipped in accordance with DOT requirements is either transferred to KAFB Explosive Ordnance Division or burned at the Thermal Treatment Facility. The Thermal Treatment Facility is a very small facility with a per burn capacity limited to 28 g of explosives, 9 kg of explosive-contaminated media, or 2 gal of explosive-contaminated liquid.

5.10.4.2 Alternatives

5.10.4.2.1 No Action

The FY1996 base year quantity of 2.95 lb of material that was treated at the Thermal Treatment Facility was unusually low. In a more typical year (for example, CY1995), the facility treated a total of 19.95 lb of waste. The FY2003 and FY2008 estimates of 336 lb of waste that the facility will treat annually is an average of the quantities of waste that the facility treated in 1995, 1996, and 1997, while the Light-Initiated High Explosive Facility was not operational, plus the average of quantities of waste that the facility treated in 1990 and 1991, while the Light-Initiated High Explosive Facility was operational. The FY2003 and FY2008 estimates assume that Light-Initiated High Explosive Facility becomes operational sometime before then, that the City of

Albuquerque issues the facility yearly open burn permits at or above 336 pounds, and that the average amount of waste that other programs generate does not change. The FY2008 estimate also assumes that the Thermal Treatment Facility's RCRA permit is reissued in FY2005.

5.10.4.2.2 Expanded

The estimate of 1,200 lb of waste treated at the Thermal Treatment Facility for the expanded alternative assumes that:

- Sixty burns are conducted at the Thermal Treatment Facility at 20 lb of waste (not 20 lb net explosive weight) per burn.
- The facility's RCRA permit is reissued to treat up to current limit of 7,300 lb of waste per year (SNL/NM does not expect to ever burn 7,300 lb of waste in a year).
- The City of Albuquerque issues yearly open burn permits to burn up to five times the current maximum amount of 240 lb of waste per year.

5.10.4.2.3 Reduced

The Thermal Treatment Facility's operational capability can be maintained without treating any waste. The reduced alternative assumes that the RCRA permit is maintained through the expiration date (December 4, 2004) regardless of whether the facility treats waste and that all permit requirements, such as weekly inspections and maintenance, are met.

ACRONYMS, INITIALISMS, AND ABBREVIATIONS

mCi - micro-Curie(s)

mg - microgram(s)

mm - micrometer(s)

AC - alternating current

AEC - Atomic Energy Commission

AFWL - Air Force Weapons Laboratory

AHR - advanced hydrodynamic radiography

AICE - American Institute of Chemical Engineers

ALARA - as low as reasonably achievable

ALEC - Advanced Laser External Cavity

ANSI - American National Standards Institute

ASME - American Society of Mechanical Engineers

BDBA - beyond design-basis accident

BST - building source term

BTU - British thermal unit

CEDE - committed effective dose equivalent

CFR - Code of Federal Regulations

CHEST - Conventional High Explosives & Simulation Test (Chestnut Site)

CHNO - carbon, hydrogen, nitrogen, and oxygen (explosives)

Ci - Curie(s)

cm - centimeter(s)

CSPRA - Compact Short-Pulse Repetitive Accelerator

CTB - Cathode Test Bed

CTF - Coyote Test Field

CY - calendar year

DARHT - Dual-Axis Radiographic Hydrotest

DAS - data acquisition (system)

dB - decibel(s)

DBA - design basis accidents

DC - direct current

DIS - diagnostic instrumentation system

DoD - Department of Defense

DOE - Department of Energy

DOE/AL - Department of Energy/Albuquerque Operations Office

DOE/KAO - Department of Energy/Kirtland Area Office

DOT - Department of Transportation

DP - Defense Programs

dpm - disintegrations per minute

DU - depleted uranium

EBA - evaluation-basis accidents

EDE - effective dose equivalent

EOC - Emergency Operations Center

ER - environmental restoration

ES&H - environment, safety, and health

eV - electron volt(s)

FAIT - Facilities Asbestos Implementation Team

FHA - fault hazard analysis

FMEA - failure modes and effects analysis

FPAC - Firing Pad Access Control

fpm - feet per minute

fps - feet per second

FREC - Fuel Ringed External Cavity

ft - foot or feet

FTE - full-time equivalent

FY - fiscal year

g - gram(s)

gal - gallon

HA - hazards analysis

HC - hazard category

HEPA - high-efficiency particulate air (filter)

HERMES - High-Energy Radiation Megavolt Electron Source

HMX - octohyrotetranitrotetraozcine

HNAB - hexanitrostilbene

HVAC - heating, ventilation, and air conditioning

Hz - Hertz

IBEST - Ion Beam Surface Treatment

ICF - Inertial Confinement Fusion

ICS - instrumentation and control system

IEEE - Institute of Electrical and Electronics Engineers

IDLH - immediately dangerous to life and health

IMP - Intermediate Pulser

in. - inch(es)

ISMS - integrated safety management system

IST - initial source terms

IWFO - Intelligence Work for Others

J - joule

KAFB - Kirtland Air Force Base

kA - kiloampere(s)

kCi - kilo-Curie(s)

keV - kilo electron volt(s)

kg - kilogram(s)

kJ - kilojoule(s)

km - kilometer(s)

kW - kilowatt(s)

kV - kilovolt(s)

l - liter(s)

lb - pound(s)

LEVIS - laser evaporation ionization source

LEWS - Lightning Early Warning System

LIBORS - Laser Ionization Based on Resonant Saturation (System)

LICA - Low-Intensity Cobalt Array

LIVA - linear induction voltage adder

LMPL - Liquid Metal Processing Laboratory

LPF - leak path factor

m - meter(s)

MA - mega-ampere

MACCS - MELCOR Accident Consequence Code System

mCi - milli-Curie

MeV - mega electron volt(s)

mg - milligram(s)

mi - mile(s)

MITL - magnetically insulated transmission line

ml - milliliters

mm - millimeter(s)

MPC - microsecond pulse compressor

mrem - millirem

MSDS - material safety data sheet

MTA - Marx trigger amplifier

MTG - Marx trigger generator

MV - megavolt(s)

MW - megawatt(s)

NASA - National Aeronautics and Space Administration

NEC - National Electrical Code

NEPA - National Environmental Policy Act

NESHAP - National Emission Standards for Hazardous Air Pollutants

NEST - Nuclear Emergency Search Team

NFPA - National Fire Protection Association

NG - nitroglycerin

NHZ - nominal hazard zone

NIF - National Ignition Facility

NRU - neutron radiography unit

NSA - National Security Agency

NSTTF - National Solar Thermal Test Facility

ODMS - oxygen deficiency monitor system

OP - operating procedure

O&SHA - operating and support hazard analysis

OSHA - Occupational Safety and Health Administration

PBFA - Particle Beam Fusion Accelerator

PHS - primary hazards screening

PBX - plastic bonded explosives

PCB - polychlorinated biphenyl

PDFL - Photovoltaic Device Fabrication Laboratory

Pe - probability of event occurring per year

PETN - pentaerythritol tetranitrate

PFL - pulse-forming lines

PHS - primary hazard screening

PK1D - point kinetics, one-dimensional (thermal analysis code)

PMMA - Polymethyl methacrylate

ppm - parts per million

PPS - plant protection system

psi - pounds per square inch

PV - photovoltaic

RCF - refractory ceramic fiber

RCRA - Resource Conservation and Recovery Act

RCSC - Radiological and Criticality Safety Committee

RCT - radiological control technician

RDX - hexahydrotrinitrotriazine

Rf - radio frequency

RGD - radiation-generating device

RHEPP - repetitive high-energy pulsed power

RMMA - radioactive material management area

rpm - revolutions per minute

SABRE - Sandia Accelerator and Beam Research Experiment

SCB - steel confinement box

SDI - Strategic Defense Initiative

SGB - shielded glove box

SHA - system hazard analysis

SNL - Sandia National Laboratories

SNL/NM - Sandia National Laboratories/New Mexico

SNM - special nuclear material

SOP - standard operating procedure

SPHINX - Short-Pulse High Intensity Nanosecond X-Radiator

STAR - Shock Thermodynamics Applied Research Facility

STB - steel transfer box

STF - Subsystem Test Facility

STP - storage/transfer pool

SWEIS - sitewide environmental impact statement

TATB - triaminotrinitrobenzene

TNT - trinitrotoluene

TW - terawatt(s)

UL - Underwriters Laboratory

UNO - United Nations Organization (hazard classification and compatibility group)

USQ - unreviewed safety question

UV - ultraviolet

V - volt(s)

VDL - vacuum diode load

VIS - vacuum insulator stack

WFO - Work for Others

YAG - yttrium aluminum garnet

GLOSSARY

Accelerator - An accelerator is a device that employs electrostatic or electromagnetic fields to impart kinetic energy to molecular, atomic, or subatomic particles and that is capable of creating a radiation field greater than 5 mrem/hr at 30 cm from the exterior of the device under maximum operating conditions.

Administrative control - Method of controlling employee exposure by job rotation, work assignment, or time periods away from the hazard.

Barrier (physical) - Any device or method that effectively prevents contact with a recognized hazard. Examples include railings, rope, fences, barricades, shields, enclosures, rubber mats, plastic and metallic guards, or elevation above 8 feet (i.e., guarded by height).

Basis for interim operation - A document demonstrating that SNL personnel can conduct facility operations at an acceptable level of safety before development of more detailed safety documentation as required by DOE 5480.22 and DOE 5480.23 and before DOE approves that documentation.

Buddy system - Working with another person nearby who can provide immediate assistance if necessary.

Chemical - Any element, chemical compound, or mixture of elements and/or compounds.

Confined space - A confined space is a space which:

- Allows personnel to bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit.
- Is not designed for continuous human occupancy.

Controlled access area - Access to onsite roadways is controlled if temporary or permanent physical access control barriers are provided. Examples of physical barriers include fences, DOE- or contractor-controlled guard gates, and security roadblocks. Passive barriers, such as signs, do not provide controlled access.

Corrosive material - A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. For example, a chemical is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U.S. Department of Transportation in Appendix A to 49 CFR Part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours. This term does not refer to action on inanimate surfaces.

Electrical hazard - Includes, but is not limited to, parts of electrical circuits operating at 50 volts or greater that are not guarded to protect personnel from accidental contact.

Electrical worker - A qualified person assigned to electrical or electronic work who uses electrical equipment or instruments other than hand tools or typical office equipment.

Environmental checklist/action description memorandum - The environmental checklist/action description memorandum communicates the “first order” environmental considerations to be included in the decision-making process and serves as a planning tool for evaluating potential environmental impacts prior to committing SNL to a course of action. It is also used to determine if an environmental assessment or an environmental impact statement is necessary.

ES&H standard operating procedure (ES&H SOP) - A document used to help plan the conduct of hazardous activities by describing the activity, the associated hazards, and the mitigation of those hazards. ES&H SOPs are intended for use by one or more organizations.

Event - An incident, situation, or condition that has or may have an undesirable effect on the safety or health of people, or on the environment.

Explosive - Any chemical compound or mechanical mixture that, when subjected to heat, impact, friction, shock, or other suitable initiation stimulus, undergoes a very rapid chemical change that creates large volumes of highly heated gases that exert pressures in the surrounding medium. This term applies to materials that either detonate or deflagrate. Explosives include primary and secondary explosives, propellants, and pyrotechnics. SNL does not regulate household materials such as matches or gasoline as explosives.

Explosive waste - Any explosive substance, article, or explosive-contaminated item that cannot be used for its intended purpose and does not have a legitimate investigative or research use. Examples include:

- Unstable explosive substances or articles
- Wipes, filters, or debris contaminated with explosives
- Scraps, cuttings, chips, fines, etc. from plastic, composite, or sheet explosives
- Explosives dissolved in solvents
- Damaged or misfired explosive articles
- Small quantities of bulk explosives, pyrotechnics, and propellants for which there are no known reapplication uses

Any of the above examples that have an investigative or research use are not waste until the owner determines that there is no further legitimate need or use for them.

Facility - Any equipment, structure, system, process, or activity that fulfills a specific purpose. Examples include accelerators, storage areas, fusion research devices, nuclear reactors, production or processing plants, coal conversion plants, magnetohydrodynamics experiments, windmills, radioactive waste disposal systems and burial grounds, environmental restoration activities, testing laboratories, research laboratories, transportation activities, and accommodations for analytical examinations of irradiated and nonirradiated components.

Facility electrical distribution system - Includes transformers, panel boards, receptacles (wall outlets), switches, and other pieces of equipment that are permanently wired into the facility electrical distribution system and that are not specifically identified as “user” equipment.

Fissile material - Any material consisting of or containing one or more of the fissile radionuclides, which are plutonium-238, -239, and -241 and uranium-233 and -235. Neither natural nor depleted uranium is a fissile material. Fissile materials are classified according to the controls needed to provide nuclear criticality safety during storage and transportation.

Flammable liquids - Liquids that vaporize at relatively low temperatures, that can easily ignite at room temperatures, and that have a flash point lower than 100°F.

General-use facilities - General-use facilities are those facilities containing hazards routinely encountered and accepted by the public, such as automobile repair shops, university laboratories, gasoline stations, and paint and hardware stores. Standard office facilities generally pose lower hazard levels than those presented by general-use facilities and are not classified as general-use facilities except under special circumstances.

Hazard - The likelihood that an adverse effect will result from a given set of exposure conditions.

Hazardous chemical - A chemical which presents a physical hazard or health hazard.

Hazardous waste - Waste that meets the definition of a solid waste and meets any one of the following conditions: exhibits, on analysis, any of the characteristics of a hazardous waste; has been named as a hazardous waste and listed as such in 40 CFR 261; is a mixture containing a listed hazardous waste and a non-hazardous solid waste; is a waste derived from the treatment, storage, or disposal of a listed hazardous waste; or is not excluded from regulation as a hazardous waste.

Hazards analysis - A hazards analysis identifies the hazards associated with a process or operation, identifies available hazard controls, and evaluates the adequacy of these controls.

Hazards assessment document - The hazards assessment document is the basis for developing the emergency response plan for a facility or site. It considers accident initiators such as sabotage or terrorist attacks, which are not considered by the safety analysis process.

Incompatible waste - The concept of incompatibility refers to the spontaneous interaction between chemicals or chemicals and materials that can harm human health or the environment through:

- Violent reactions
- Release of toxic or flammable fumes
- Fire or explosion
- Evolution of heat and pressure

Mixed waste - Mixed waste is any solid waste that contains both a hazardous waste component, as defined in the *Resource Conservation and Recovery Act* and implementing regulations, and a radioactive waste component, as defined in DOE orders.

A state may define additional waste as hazardous waste, thus causing other hazardous and radioactive waste mixtures to be regulated by the state as mixed waste.

Mixed waste generator - A mixed waste generator is any person or organization generating mixed waste or causing a material to be subject to mixed waste regulations. Generators are responsible for the generation and subsequent management of mixed waste as part of their occupation or position. Generators may include managers, their employees, and contractors.

Net explosive weight - The weight of an explosive itself or an explosive contained within an ordnance item or device.

Nonnuclear facilities, high-hazard - High-hazard nonnuclear facilities are those with the potential for onsite or offsite impacts on large numbers of people or for major offsite impacts on the environment.

Nonnuclear facilities, low-hazard - Low-hazard nonnuclear facilities are those that present minor onsite impacts (within the boundaries of SNL-controlled areas) and negligible offsite impacts (outside the boundaries of SNL-controlled areas) to people or the environment. Low-hazard nonnuclear facilities or operations may present:

- Significant damage to the experiment or operational area (temporary loss of the use of the equipment or facilities).
- Minor injury to the workers involved in the activity, including exposures that are unlikely to produce more than minor injury or temporary discomfort (for example, cuts, bruises, and minor burns).
- Negligible (unmeasurable) injury to workers not involved in the project or activity and offsite people.
- Negligible impact to the offsite environment (outside the boundary of SNL-controlled areas).

Nonnuclear facilities, moderate-hazard - Moderate-hazard nonnuclear facilities are those that present considerable potential onsite impacts to people or to the environment but only minor offsite impacts, at most.

Nonpermit confined space - A nonpermit confined space is a space which meets the definition of a confined space, but after evaluation, is found to have minimal potential for hazards. This type of confined space requires an entrant to complete a nonpermit confined space checklist.

Nuclear facility - A nuclear facility means reactor and nonreactor nuclear facilities, as defined in DOE 5480.23, that require the preparation of a safety analysis report.

Nonreactor nuclear facility means those activities or operations that involve radioactive and/or fissionable material in such form and quantity that a nuclear hazard potentially exists to the employees or the general public.

Included are activities or operations that:

- Produce, process, or store radioactive liquid or solid waste, fissionable materials, or tritium.
- Conduct separation operations.
- Conduct irradiated materials inspection, fuel fabrication, decontamination, or recovery operations.
- Conduct fuel enrichment operations.
- Perform environmental remediation or waste management activities involving radioactive materials.

Incidental use and generating of radioactive materials in a facility operation (e.g., check and calibration sources, use of radioactive sources in research and experimental and analytical laboratory activities, electron microscopes, and X-ray machines) would not ordinarily require the facility to be included in this definition. Accelerators and reactors and their operations are not included.

Reactor means, unless it is modified by words such as containment, vessel, or core, the entire reactor facility, including the housing, equipment, and associated areas devoted

to the operation and maintenance of one or more reactor cores. Any apparatus that is designed or used to sustain nuclear chain reactions in a controlled manner, including critical and pulsed assemblies, and research, test, and power reactors, is defined as a reactor. All assemblies designed to perform subcritical experiments that could potentially reach criticality are also to be considered reactors. Critical assemblies are special nuclear devices designed and used to sustain nuclear reactions. Critical assemblies may be subject to frequent core and lattice configuration change and may be used frequently as mockup of reactor configurations.

Occurrence - An occurrence is a problem, concern, failure, malfunction, or deficiency in equipment, process, procedure, or program. It is also any condition or event that could have an adverse effect on safety, the environment, health, security, or operations. Occurrences may, or may not, be reportable to DOE depending on their level of seriousness. Occurrences are reportable to DOE if they are determined to be:

- Emergency
- Unusual
- Off-normal

Operating procedure - An operating procedure (OP) is a document that provides step-by-step instructions for specific operations (normal, postulated abnormal, and emergency operations) to ensure that activities are performed correctly, safely, and consistently. Typically, organizations develop their own OPs for internal use within the organization. OPs may exist as independent documents, unless they describe operations involving hazards which require the development of environment, safety, and health standard operating procedures (ES&H SOPs). OPs may not substitute for ES&H SOPs, although they may supplement them.

Operational safety requirements - Operational safety requirements define the operating limits of facility, operation, or activity control parameters for nonnuclear facilities that can pose a risk to the public. Operational safety requirements are included in the facility safety documentation.

Overpack - An enclosure other than a freight container that protects or facilitates handling of a package, or consolidates two or more packages.

Permit, confined space entry - A written document that authorizes and controls entry into a permit-required confined space. The permit specifies the hazards of the confined space and outlines the controls required for entry.

Permit-required confined space - A permit-required confined space is a space which meets the definition of a confined space, and after serious evaluation, has actual or potential hazards which have been determined to require written authorization for entry. This type of confined space requires a confined space entry permit and an attendant to be present during entry activities.

Primary container - The container in which the waste will remain when it is removed from the generator's satellite.

Primary hazard screening (PHS) - An electronic, online software process to determine the hazard level and identify hazards of a facility, activity, or operation. Primary hazard screenings also identify training and regulatory requirements.

Radioactive source - Radioactive material or equipment containing radioactive material that spontaneously emits ionizing radiation put to some purpose.

Radioactive waste - Solid, liquid, or gaseous material that contains radionuclides regulated under the *Atomic Energy Act of 1954*, as amended, and is of negligible economic value considering costs of recovery. Examples of common radioactive waste includes depleted uranium, activated materials, fission products, and tritium-containing waste.

Radioactive waste generator - Any person or organization generating radioactive waste or causing a material to become radioactive waste intentionally or under unplanned circumstances. Generators may include: managers, other SNL employees, and contractors who are responsible or potentially may be responsible for the generation and subsequent management of radioactive waste as a part of their occupation or position.

Radiologically controlled area - A radiologically controlled area (RCA) is an area to which access is controlled to protect personnel from exposure to radiation and radioactive material.

Release to the environment, oil - Any amount of oil, grease, or fuel that enters a building drain or reaches the earth or water outside a building wall or secondary containment.

Reportable quantity - Quantity of material or product compound or contaminant which, when released to the environment, is reportable to a regulatory agency.

Safety analysis - A process that provides systematic identification of hazards within a given DOE operation, that describes and analyzes the adequacy of measures taken to eliminate or otherwise control identified hazards, and that analyzes and evaluates potential accidents and their associated risks.

Safety analysis report - The report that documents the adequacy of safety analysis for a facility to ensure that the facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations.

Safety assessment - A safety assessment is an evaluation and risk analysis of a nonnuclear facility to determine its level of risk and the need for a safety analysis report. A safety assessment systematically:

- Identifies the hazards of a facility.
- Describes and analyzes the adequacy of measures taken to eliminate or otherwise control identified hazards.
- Analyzes and evaluates potential accidents and their associated risks.

Safety assessment document - A safety assessment document contains the results of a safety analysis for an accelerator facility or one of its constituents. DOE 5480.25, *Safety of Accelerator Facilities*, uses the label "safety assessment document" to distinguish this type of documentation from the safety analysis report for nuclear and high-hazard nonnuclear facilities.

Secondary containment - Any structure or device that has been installed to prevent leaks, spills, or other discharges of stored chemicals, waste, oil, or fuel from storage, transfer, or end-use equipment from being released to the environment. Examples of secondary containment include pans, basins, sumps, dikes, berms, or curbs.

Site - A specific SNL-controlled area of land upon which SNL controls access and egress, such as those locations in Albuquerque, Livermore, or Tonopah. A site is an area of land that contains a DOE facility or facilities that are either owned or leased by DOE or the federal government. The land may be divided by public right-of-ways.

SNL personnel - SNL employees and Sandia-directed contractors (contract personnel who work under a contract for which SNL retains accountability for the outcome of the work and whose work is routinely directed by SNL employees).

Spill - Any uncontained release of a hazardous material into the environment, including releases into a secondary containment unit. Spill, release, and leak are synonymous when appropriate.

Spill, oil - Any unplanned release of a petroleum product in any amount.

Standard industrial hazard - A facility or project activity that has hazards of the type and magnitude that are routinely encountered and/or accepted by the public in everyday life. This includes hazardous materials or operations encountered in general industry in appropriate applications that are adequately controlled by Occupational Safety and Health (OSHA) regulations or one or more national consensus standards (e.g., ASME, ANSI, NFPA, IEEE, NEC). This would apply where these standards are adequate to define special safety requirements, unless in quantities or situations that could significantly impact large numbers of people. In the event a facility or project activity receives a hazard classification of standard industrial hazard (SIH), the primary hazard screening (PHS) itself will be the necessary and sufficient level of safety documentation.

Technical safety requirements - Technical safety requirements are conditions, safe boundaries, and management and administrative controls that are necessary to ensure the safe operation of a nuclear facility and to reduce the potential risk to the public and facility workers from uncontrolled releases of radioactive materials or from radiation exposure due to inadvertent criticality.

The elements of a technical safety requirements document include:

- Safety limits
- Operating limits
- Surveillance requirements
- Administrative controls
- Use and application instructions and the bases thereof